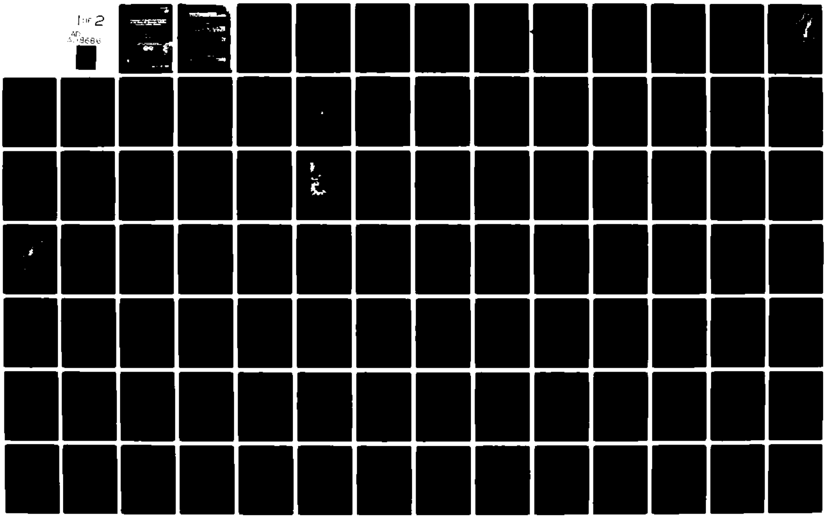
AD-A118 686 NAVAL WEAPONS CENTER CHINA LAKE CA F/G 8/7
EVALUATION OF GEOTHERMAL POTENTIAL OF THE NAVAL AIR WEAPONS TRA--ETC(U)
APR 82 A M KATZENSTEIN, K J DANTI
UNCLASSIFIED NWC-TP-6359 NL



AD A118686

[illegible]
of the Naval Air [illegible]
Complex, [illegible]

[illegible]

NAVAL WEAPONS CENTER
CHINA LAKE, CALIFORNIA [illegible]

[illegible]

[illegible]

Approved by
[illegible]
Capt., CEC, U.S. Navy
Public Works Officer
[illegible]

Released for publication by
[illegible]
[illegible]

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER NWC TP 6359	2. GOVT ACCESSION NO. AD-A118 686	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) EVALUATION OF GEOTHERMAL POTENTIAL OF THE NAVAL AIR WEAPONS TRAINING COMPLEX, FALLON, NEVADA		5. TYPE OF REPORT & PERIOD COVERED Interim report - FY 1981
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Allan M. Katzenstein and Kathy J. Danti		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS Naval Weapons Center China Lake, CA 93555		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS Naval Civil Engineering Laboratory Project No. S0829-SL
11. CONTROLLING OFFICE NAME AND ADDRESS Naval Weapons Center China Lake, CA 93555		12. REPORT DATE April 1982
		13. NUMBER OF PAGES 110
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Geothermal exploration
Geothermal potential
Naval Air Station Fallon
Range Bravo 16
Range Bravo 19
Naval Air Weapons Training Complex, Fallon, Nev.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

See back of form.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE
S/N 0102-LF-014-6601

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

(U) *Evaluation of Geothermal Potential of the Naval Air Weapons Training Complex, Fallon, Nevada*, by Allan M. Katzenstein and Kathy J. Danti. China Lake, Calif., NWC, April 1982. 110 pp. (NWC TP 6359, publication UNCLASSIFIED.)

(U) The Geothermal Utilization Division of the Naval Weapons Center has been exploring geothermal potentials at various sites of the Naval Weapons Training Complex, Fallon, Nev. The purpose of the exploration program is to determine adequacy of geothermal resources for energy self-sufficiency of the Naval Air Station Fallon.

(U) The present report presents the results of studies at NAS Fallon and Ranges Bravo 16 and 19 that included thermal gradient drilling: aeromagnetics, gravity, and land magnetics studies; and the drilling of one 2,000-foot observation hole. The results indicated a high geothermal potential at NAS Fallon and better than average potentials for Ranges Bravo 16 and 19.

Accession For
NTIS GRA&I ☒
DTIC TAB ☐
Unannounced ☐
Justification
By
Distribution/
Availability Codes
Dist | Avail and/or Special
A

DTIC COPY INSPECTED 2

CONTENTS

Appendixes:

Figures:

ACKNOWLEDGMENT

The able assistance of C. R. Rodgers, Jack Neffew, and BUC Ted Mort, who assisted in the collection of the gravity and magnetic data, and Dr. J. A. Whelan for his contributions in Appendix E is gratefully acknowledged. These personnel are members of the Geothermal Utilization Division, Public Works Department.

INTRODUCTION

The Geothermal Utilization Division at the Naval Weapons Center (NWC) was tasked to perform a geothermal exploration program at the Naval Air Weapons Training Complex (NAWTC), Fallon, Nevada. The program was implemented to determine which of NAWTC's lands, if any, contained adequate geothermal resources to develop energy self-sufficiency for the central communication, business, and housing facilities located at Naval Air Station (NAS) Fallon. The results of the initial evaluations, that of Range Bravo 17 and the Shoal Site, were published in March 1980.[1] The recommendation was that further work at these two sites was not warranted due to a low probability of geothermal potential. The next evaluation was published in May 1980[2] which discussed both the findings of initial thermal gradient work at NAS Fallon and the results of a mercury survey taken at NAS Fallon, Range Bravo 16, Range Bravo 19, and Range Bravo 20. The report recommended further work at NAS Fallon and Ranges Bravo 16 and 19. Range Bravo 20 was dropped from further consideration due to the distance between the Range and NAS Fallon.

This report presents the results of studies undertaken at NAS Fallon, Range Bravo 16, and Range Bravo 19 since the May 1980 publication.[2] The studies included further thermal gradient drilling, aeromagnetics, gravity, land magnetics, and the drilling of one 2,000-foot (610-m) observation hole. The results indicate that NAS Fallon has a high geothermal potential, while Range Bravo 16 and Range Bravo 19 have a better than average geothermal potential better evaluated by further work.

---

[1]Naval Weapons Center. *Evaluation of Geothermal Potential of Range Bravo 17 and the Shoal Site, Naval Air Station, Fallon*, by J. A. Whelan, C. R. Rodgers, J. Brown, and Jack Neffew. China Lake, Calif., NWC, March 1980. (NWC TP 6142, publication UNCLASSIFIED.)

[2]------. *Fallon Geothermal Exploration Project, Naval Air Station, Fallon, Nevada*, by James L. Bruce. China Lake, Calif., NWC, May 1980. (NWC TP 6194, publication UNCLASSIFIED.)

GEOGRAPHY

The Naval Air Weapons Training Complex (NAWTC) is located within the Basin and Range physiographic province in Churchill County, Nevada. It includes NAS (Mainbase) Fallon, the Shoal Sites, Electronic Warfare (EW) Range, and Bombing Ranges Bravo 16, 17, 19, and 20. NAS Fallon houses the central facilities for NAWTC and is located nearly 50 miles (81 km) east of Reno, Nevada and 5 miles east-southeast of Fallon, Nevada (Figure 1). Range Bravo 16 is an air-to-ground bombing range located 12 miles (19 km) west-southwest of NAS Fallon. Range Bravo 19 is also an air-to-ground bombing range and is located nearly 18 miles (29 km) south of NAS Fallon. The other ranges are located to the north and east of NAS Fallon.

The terrain in this area is largely sagebrush-covered desert, except for the agricultural area created around the NAS Fallon area by the construction of the Newlands irrigation system in the 1920s. Surface water is scarce, except for that found in irrigation canals and in the Truckee and Carson Rivers. Based on climatic records[3] published through 1972, the average mean air temperature at NAS Fallon is 53°F (11.7°C). Precipitation is slightly over 5 inches.

REGIONAL BACKGROUND

BASIN AND RANGE PROVINCE

The Basin and Range physiographic province is characterized by a succession of nearly parallel, northerly elongated valleys and mountain ranges. This configuration is due primarily to a west-northwest/east-southeast crustal extension of a region from middle Utah to eastern California, and from Canada to Mexico. This extension, estimated at 31 to 62 miles (50 to 100 km) since the late Cenozoic, has created a pattern of rupture which has simplistically been described as high-angle, normal block faults forming a system of grabens and horsts. In actuality, the rupture system is more complex and, in many areas of the province, forms patterns which are nearly rhomboid or rectilinear in nature accompanied by considerable warping and tilting of blocks especially near the ends of the grabens.[4] While the mechanism which produced the complexity of

---

[3]Naval Weather Service. "Station Climatic Summary, Fallon, Nevada." 1972.

[4]George A. Thompson and Dennis B. Burke. "Regional Geophysics of the Basin and Range Province," in *Annual Review of Earth and Planetary Sciences*, Vol. 2 (1974) pp. 213-238.

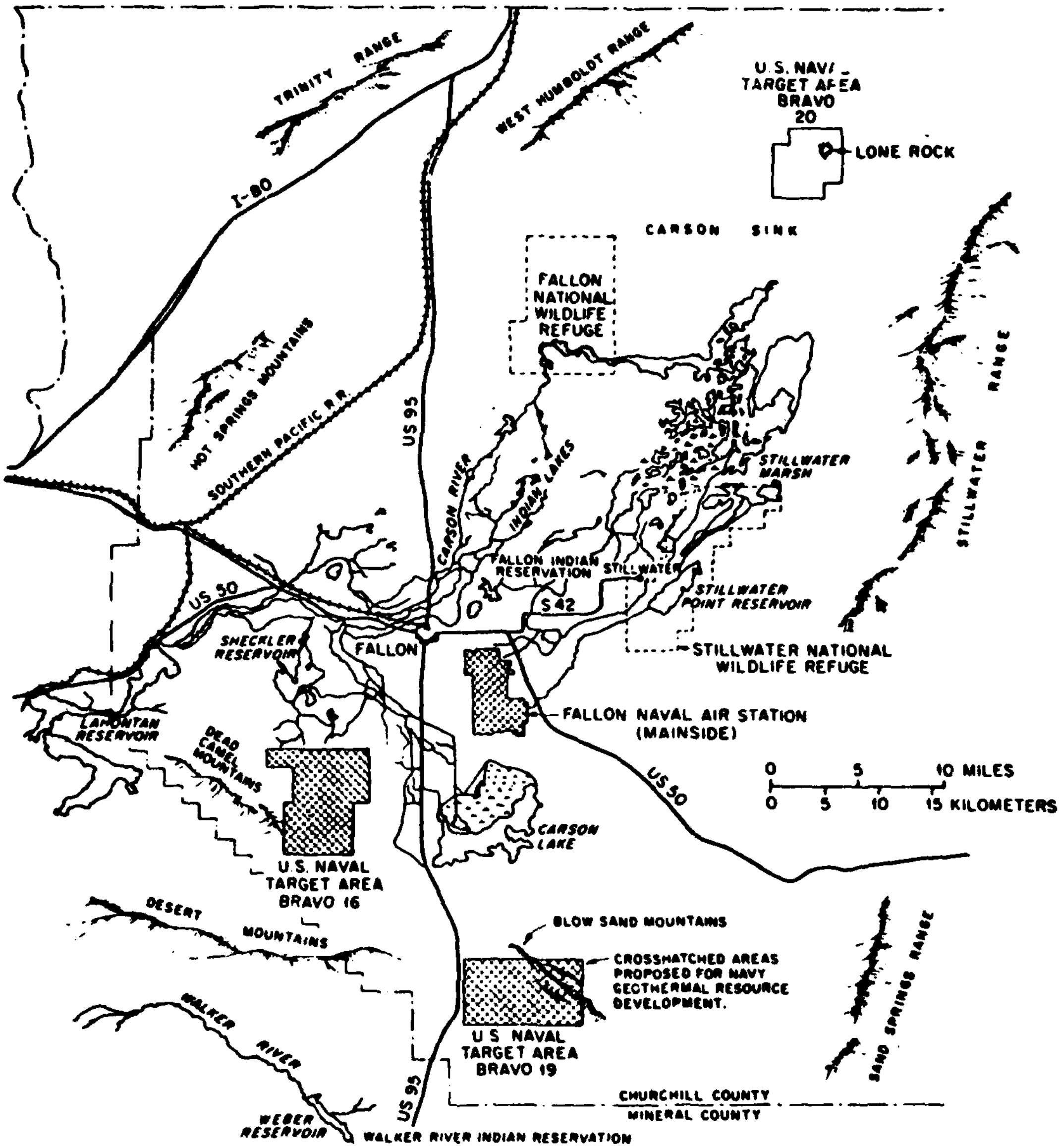


FIGURE 1. Location Map Showing NAS Fallon, Bravo 16 and Bravo 19.[5]

---

[5]Naval Weapons Center. *Western Division Naval Facilities Engineering Command Programmatic Preliminary Environmental Assessment (PPEA) for the Fallon Naval Air Station Geothermal Development Program, Fallon, Nevada.* China Lake, Calif., NWC, 1981. (NWC AdPub 263, publication UNCLASSIFIED.)

structure is not known, it has been hypothesized that the stress system may have changed over time, possibly due to the influence of older structures and anisotropy in the mechanical properties of the crust.

Although the Basin and Range province is an elevated region averaging 0.62 to 1.24 miles (1 to 2 km) above sea level, seismic studies have indicated that the crust beneath the province is roughly two-thirds that of other continental areas of nearly the same elevation (footnote 4). Indeed, gravity work reported by Woollard[6] indicates most of the region to be deficient in mass, with an average anomaly of about -10 mgal. In addition, it has been found that the Basin and Range province has a well-developed upper mantle low velocity zone (LVZ) for both P- and S-waves, and an abnormally low velocity for the wave traveling in the uppermost mantle below the M-discontinuity (footnote 4). Heat flow studies indicate that the Basin and Range province has an average value of 2.0 heat flow units (HFU), which is 0.5 HFU higher than continental average.[7] Lachenbruch,[8] using an exponential model, calculated temperatures at an 18.6-mile (30-km) depth to be 1292 to 1832°F (700 to 1000°C) beneath the province. Thus, temperatures in the crust may reach the melting range for granite, while the upper mantle may contain molten basalt. Thompson and Burke (footnote 4) believe that these high temperatures, coupled with a tremendous amount of late Cenozoic volcanic rocks, fortify the widespread hypotheses that the observed thin crust and shallow, low velocities measured beneath the crust are due to partial melting beneath the Basin and Range province.

Regional Geothermal

Surface thermal activity is common throughout the Basin and Range province with a large number of hot springs found in the northern and western part of Nevada. Most hot springs are located on faults which lie close to the margins of the basins, although some lie more basinward and probably owe their existence to the Basin and Range fault system covered by recent alluvium. It is believed that these faults are used as a conduit for the geothermal fluids to migrate to the surface. Although the exact type of heat source is not known, it has been hypothesized that (1) the cooling of near surface intrusive bodies that have risen through the thin crust are supplying heat to near surface fluids (footnote 2) or

---

[6] G. P. Woollard. "Regional Variations in Gravity," in *The Nature of the Solid Earth*, ed by E. Robertson. New York, McGraw, 1972. Pp. 463-505.

[7] R. F. Roy, D. D. Blackwell, and E. R. Decker. "Continental Heat Flow," in *The Nature of the Solid Earth*, ed by E. Robertson. New York, McGraw, 1972. Pp. 504-543.

[8] A. H. Lachenbruch. "Crustal Temperature and Heat Production: Implications of the Linear Heat-Flow Relation," *Journal of Geophysical Research*, Vol. 75 (1970), pp. 3291-3300.

(2) the heat source is not maintained by a near surface intrusive, but is derived by deep convection of ground waters through a greatly fractured basement with a high thermal gradient.[9] However, due to the enormous amount of young (less than 15 million years) volcanic material that has been extruded throughout northwestern Nevada, a system of both seems possible. The emplacement of an intrusive body would have to fracture the surrounding host rock, which would provide numerous pathways and storage for the hydrothermal fluids (juvenile and meteoric). The intrusive would also produce a high thermal gradient which would provide a driving force for a convective process.

GEOLOGY OF THE CARSON DESERT AREA

INTRODUCTION

The Carson Desert is a flat, northeastward elongated triar[illegible]r-shaped graben of over 60 miles (97 km) in length and from 8 to [illegible]es (12 to 48 km) in width. It is bounded on the east by the nortl[illegible]neast trending Lahontan and Stillwater Mountains, on the west by the northeast striking Hot Springs and West Humboldt Ranges, and on the south by the Dead Camel, Desert, Blow Sand, and Cocoon Mountains. Side basins extend into the desert in the southern portion and include the Salt Wells Basin and Bass Flats (Figures 2 and 3).

The Carson Desert surrounds the Carson Sink in the northern portion of the basin and the Carson Lake to the south. The Sink is a large playa nearly 20 miles (32 km) in diameter known to contain 13,000 feet (3963 m) of Tertiary to recent sediments at a location near its present northeastern limits.[10] The Sink is a sump for the Humboldt and Carson Rivers which flow from the north and west, respectively. The Carson Lake, in the southern part of the Carson Desert, is a large, shallow lake consisting of marshland and open water. It is fed mainly by waste irrigation water from the Newlands Reclamation Project.

Near the center of the Carson Desert lie the volcanic hills of Upsal Hogback, Rattlesnake Hill, and the Soda Lake uplift. Lone Rock, another volcanic hill, outcrops near the northern limits of the Carson Sink.

---

[9] G. V. Keller, L. T. Grose, and R. A. Crewsdon. "Speculations on Nature of Geothermal Energy in Basin and Province of Western United States," in *Studies of a Geothermal System in Northwestern Nevada, Part 2*, Colorado School of Mines Quarterly, Vol. 3, No. 4 (October 1978), pp. 71-76.

[10] Douglas D. Hastings. "Results of Exploratory Drilling Northern Fallon Basin, Western Nevada," in *RMAG-UAG, 1979 Basin and Range Symposium Guidebook*, pp. 515-522.

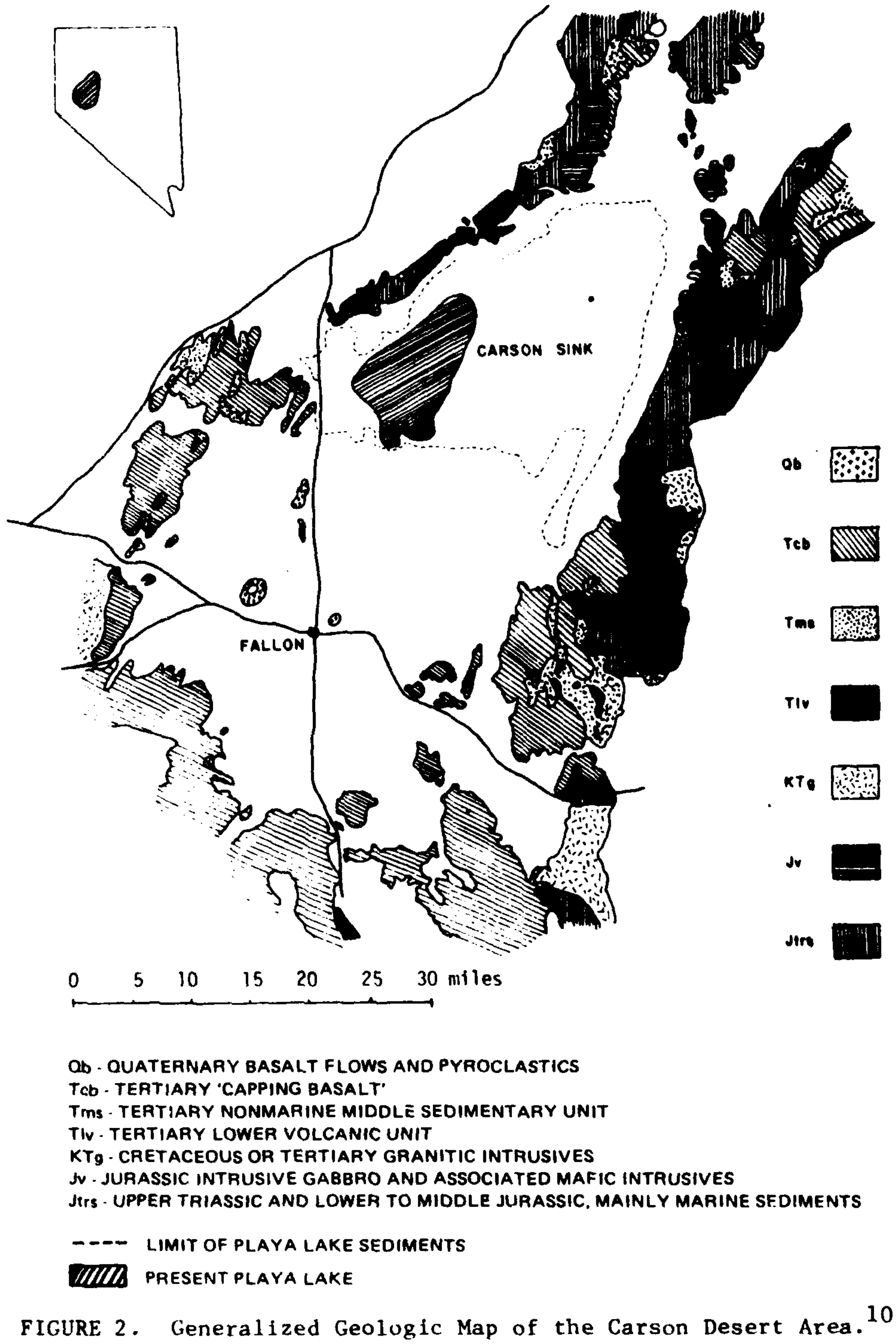
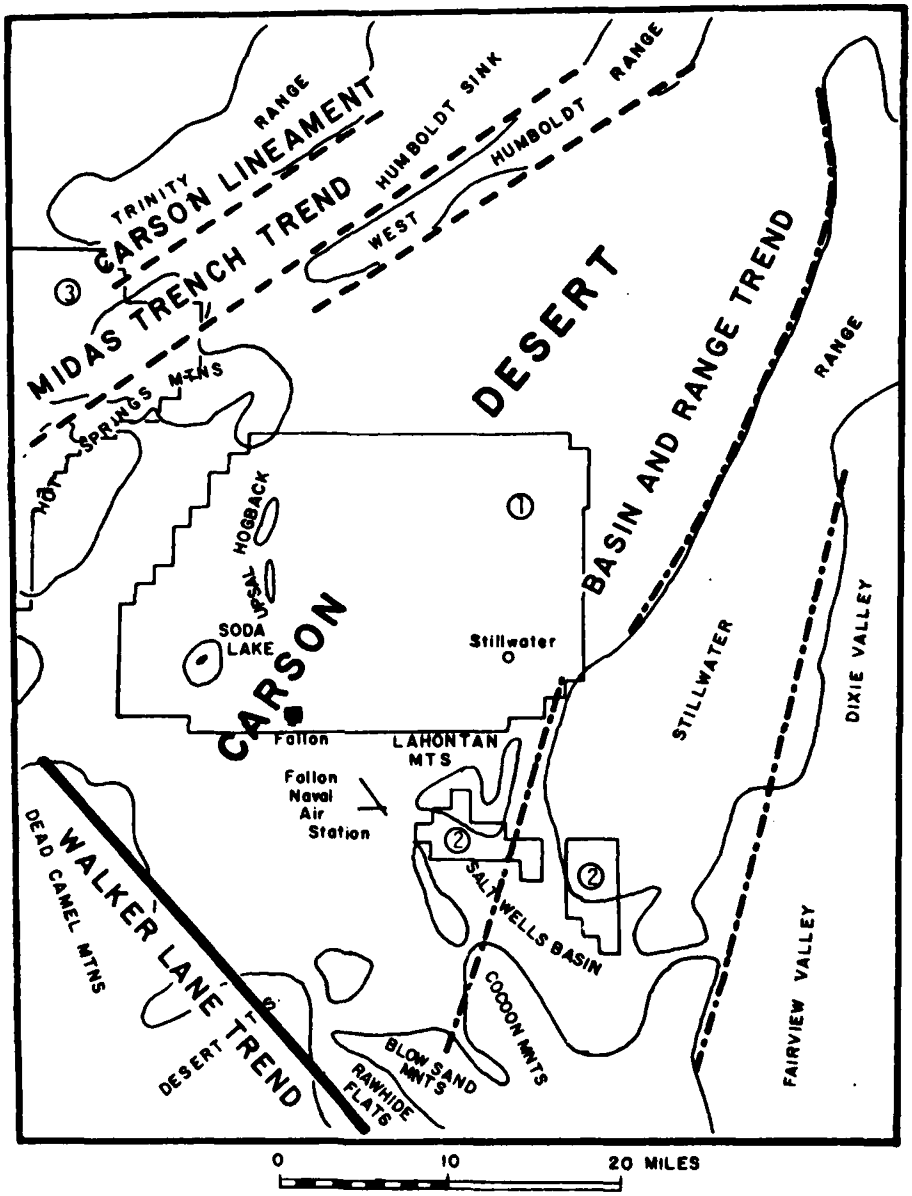


FIGURE 2. Generalized Geologic Map of the Carson Desert Area.[10]



1. Stillwater-Soda Lake KGRA
2. Salt Wells KGRA
3. Brady-Hazen KGRA

FIGURE 3. Major Structural Trends Associated With the Carson Desert.[11]

[11] Dennis T. Trexler, Brian A. Koenig, Thomas Flynn, James L. Bruce, and George Ghusn, Jr. "Low-to-Moderate Temperature Geothermal Resource Assessment for Nevada: Area Specific Studies," Nevada Bureau of Mines and Geology, University of Nevada, Reno, Nevada. U.S. Department of Energy (DOE/NV/10039-3).

MESOZOIC GEOLOGY

The oldest rocks in the Carson Desert area outcrop in the northern Stillwater Range and throughout the West Humboldt Range. They consist of a thick sequence of Late Triassic marine shales and siltstones conformably overlain by Lower Jurassic calcareous siltstones and limestones.[10,12] The sections in both locations are complexly deformed and involved in low-angle thrusting, and have been estimated at between 5,000 to 12,000 feet (1524 to 3660 m) thick.[12,13]

In the Middle Jurassic, a section of mainly fine-grained quartz arenite, sandy limestone, and limestone was deposited unconformably over the older Mesozoic rocks in the Stillwater Range (footnotes 10 and 12). In the West Humboldt Mountains a comparable unit was deposited consisting of fresh to weathered marble, gypsum, tuffs, arenite, and limestones.

In the Late Jurassic, the Mesozoic rocks in the Stillwater and West Humboldt Ranges were intruded by a gabbro and anorthosite body. Speed[14] feels that these rocks are part of a lopolith intruded at shallow depth into the Middle Jurassic sediments. Late Mesozoic granodiorites and quartz monzonites also intruded the older Mesozoic unit in the ranges which bound the Carson Desert to the north, east, and south.

Hastings (footnote 10) believes the Mesozoic section underlies the Tertiary throughout the Carson Desert area, and is generally considered to be the economic basement in terms of hydrocarbon production.

TERTIARY GEOLOGY

Tertiary rocks are more abundant throughout the Carson Desert area than those of any other system except the Quaternary, and are found outcropping in all surrounding ranges. Willden and Speed (footnote 12) did an extensive study of Tertiary outcrops throughout Churchill County and divided their findings into seven units; Morrison[15] investigated the Tertiary rocks in the southern Carson Desert and described five units; Hastings (footnote 10) divided the Tertiary into three units--a lower volcanic unit,

---

[12]Ronald Willden and Robert C. Speed. "Geology and Mineral Deposits of Churchill County, Nevada," in *Nevada Bureau of Mines and Geology*, Bulletin 83, 1974.

[13]B. M. Page. "Preliminary Geologic Map of a Part of the Stillwater Range, Churchill County, Nevada." Nevada Bureau of Mines, Map 28, 1965.

[14]R. C. Speed. "Mechanics of Emplacement of a Gabbroic Lopolith, Northwestern Nevada" (abs), *Geol. Soc. America Spec.*, Paper 82 (1966), p. 208.

[15]R. B. Morrison. "Lake Lahontan: Geology of Southern Carson Desert, Nevada." United States Geological Survey Professional Paper 401, 1964.

a nonmarine middle sedimentary unit, and a capping basalt unit. A summary of those sections which outcrop through the Carson Desert area follows.

The lower volcanic unit is composed of rhyolite to andesite and basalt flows, rhyolite and tuffs, welded tuffs, and some intrusives. In the northern Stillwater Range it is represented by a series of rhyolite ash flow tuffs interbedded with sedimentary laid sandstone and mudstone. This section, measured at 3,600 feet (1115 m) thick, has been radiometrically dated at between 30 to 17 million years. In the southern Stillwater Range the tuff series is thinned or completely nonexistent, perhaps due to erosion. It is underlain by a unit of igneous rock also of Tertiary age.

The middle sedimentary unit consists of a series of fluvio-lacustrine clays, silts, and airfall tuffs. This unit appears to have been deposited in a series of irregular lakes during a moderate orogeny.

The capping basalt unit is the youngest of the Tertiary. The unit is commonly 300 to 400 feet (91 to 122 m) thick with thicknesses up to 1,600 feet (488 m) reported by Page (footnote 13) in the southern Stillwater Range. Olivine basalt is the most common rock in the unit, which appears on all ranges surrounding the Carson Desert and probably underlies much of the basin.

QUATERNARY GEOLOGY

Quaternary sediments are the most common surface deposit and consist mainly of lacustrine sediments, alluvial fan material, and wind-blown sand (footnote 12). Morrison (footnote 15) reports sediment thickness of 625 feet (191 m) in the southern Carson Desert, while Hastings (footnote 10) reports a thickness of 6,900 feet (2104 m) to the capping basalt in the Carson Sink.

In the Quaternary a volcanic episode also extruded the basalt and basalt lapilli tuffs of Rattlesnake Hill, Upsal Hogback, and the craters holding the Soda Lakes (footnote 12). All these basalts, except for those on Rattlesnake Hill, were emplaced in the waters of Lake Lahontan, which was a large, interbasin Pleistocene lake whose maximum shoreline reached 4,380 feet (1335 m) or 515 feet (157 m) above the Carson Desert floor (footnote 15). Upsal Hogback and the craters at Soda Lakes were formed coeval with Lake Lahontan. Rattlesnake Hill is older than Lake Lahontan.

STRUCTURE

The Carson Desert area is structurally complex (Figure 3). In the north the Stillwater Range, which is controlled by the general north-northeasterly faulting of the Basin and Range province, nearly intersects the northeast trending Trinity and West Humboldt ranges. This northeast

trend, known as the Carson Lineament-Midas Trench trend, may represent an earlier axis of extension during basin and range development[16]. Hastings (footnote 10) reports that the regional trends beneath the northern Carson Desert realign from the northeast to the north-northeast with the basin deepening to the east.

In the southern half of the Carson Desert, the north-northeast trend of the Stillwater range is intersected by the northwest striking Walker Lane Trend. The Walker Lane Trend is thought to be an active structural zone as old or older than the stress which caused Basin and Range faulting.[17] As a result, the southern Carson Desert is an area of topographic discordance, with an abrupt change in the trend of mountain ranges and valleys from the north-northeast (e.g., Stillwater Range) to northwest (Dead Camel Mountains and Blow Sand Mountains). Seismic studies have indicated that the Walker Lane Trend also defines a zone where the crust thickens to the west,[18] possibly defining the eastern limits of the Sierra Nevada batholith.

On a more local scale, several fault traces have been mapped which show evidence of recent movement. The Wildcat Fault Zone is a marginal fault which extends nearly 12 miles (19 km) in the arc around the south and east sides of Carson Lake (footnote 15). *En echelon* faulting is present on the north end of the Desert Mountains and east of the Dead Camel Mountains which is probably a continuation of the Wildcat Fault Zone. Other faults trend northwestward along the eastern edge of Eight Mile Flat which were broken during a series of large earthquakes from July to December 1954 (footnote 15).

GEOTHERMAL POTENTIAL IN THE CARSON DESERT AREA

Five known geothermal resource areas (KGRAs) exist in and around the Carson Desert. These include the Dixie Valley KGRAs, northeast of NAS Fallon in Dixie Valley; the Brady-Hazen KGRA along the west side of the Hot Springs Mountains; the Wabuska KGRA southwest of the Desert Mountains; the Stillwater-Soda Lakes KGRA immediately north and northeast of Fallon; and the Salt Wells KGRA, southeast of NAS Fallon in the

---

[16] D. T. Trexler, E. J. Bell, and G. H. Roquemore. "Evaluation of Lineament Analysis as an Exploration Technique for Geothermal Energy, Western and Central Nevada." Final report of work performed for the U.S. Department of Energy under Contract No. E4-76-5-08-0671, 1978.

[17] Richard L. Nielson. "Right-Lateral Strike-Slip Faulting in the Walker Lane, West-Central Nevada," *Geological Society of America Bulletin*, Vol. 76 (1965), pp. 1301-1308.

[18] R. W. Greensfelder. "The Pg-Pn Method of Determining Depth of Focus With Applications to Nevada Earthquakes," *Seismol. Soc. America Bull.*, Vol. 55, pp. 391-403.

Salt Wells Basin. Other thermal anomalies not classified as KGRAs but of importance due to either hot springs, hot water wells, or high thermal gradients in the Carson Desert, are the Lee Hot Springs area immediately north of Range Baker 19; portions of Four Mile and Eight Mile Flats in the Salt Wells Basin; the Desert Peak area in the northern Hot Springs Mountains; and the area south of the Fallon National Wildlife Refuge in the Carson Sink. Generally, the extent and temperature of the thermal systems are not known.

SITE STUDIES OF NAS FALLON

INTRODUCTION

NAS Fallon is located in the eastern central Carson Desert approximately 5 miles (8 km) southeast of the town of Fallon, Nevada (see Figures 1 and 4). The base covers nearly 12 square miles (19 km^2) and shows little topographic relief.

Bruce (footnote 2) gives an extensive geologic description of NAS Fallon. Briefly, it is underlain by unconsolidated Quaternary sediments which include shallow lake sediments, sand, gravel, alluviums, and probably some basaltic rock extruded from nearby Rattlesnake Hill. Total depth of the sediments is known to be greater than 1,700 feet (518 m) near the center of NAS Fallon (footnote 15) and 1,800 feet (549 m) at the extreme southeast boundary. The sediments are probably underlain at depth by the Tertiary basalts described by Hastings (footnote 10).

Faults are not directly mappable on NAS Fallon due to the unconsolidated sediments and extensive surface disturbances caused by base-related activities.

GEOTHERMAL EXPLORATION - PREVIOUS STUDIES

Thermal Gradient I

NAS Fallon is located a few miles north of a hot artesian well (Well 6, Figure 4), 163 feet (50 m) deep with a reported bottom hole temperature of 170°F (77°C) (footnote 2). In an attempt to delineate any thermal anomaly associated with this temperature beneath NAS Fallon, the Navy drilled four thermal gradient holes near the southeast corner of the base (Holes 23 through 26, Figure 4 and Appendix D). The resultant gradients ranged from about 5.3°F/100 feet (9.7°C/100 m) to almost 13°F/100 feet (23.7°C/100 m), well above the 1.7 to 2.8°F/100 feet (3.0°C to 5°C/100 m) average for the Basin and Range province (footnote 1). Gradients increase to the southeast toward Well 6.

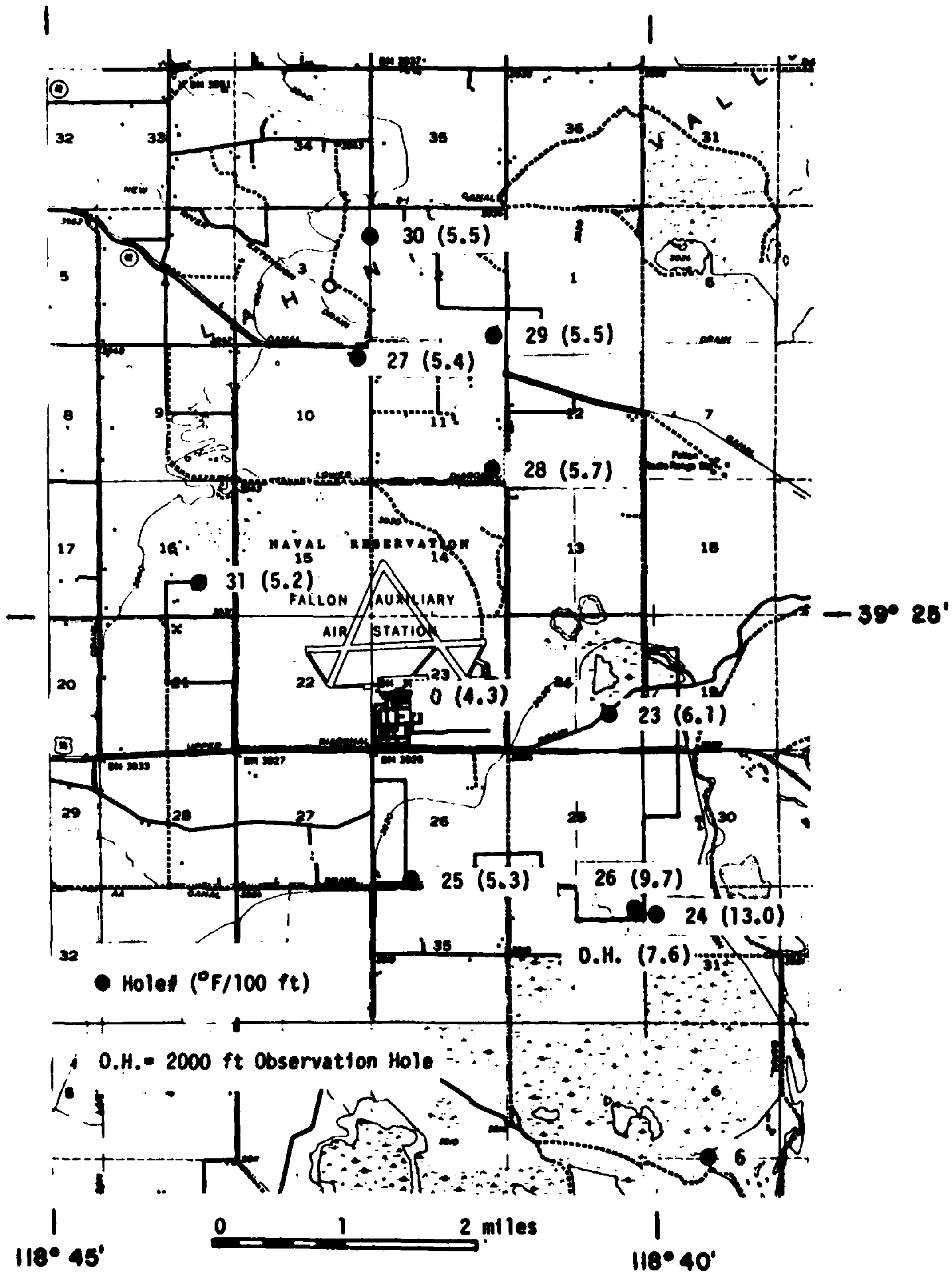


FIGURE 4. NAS Fallon Topographic Map Showing Warm Wells and Thermal Gradient Holes.

Mercury Soil Sampling

To further delineate the anomaly on NAS Fallon, a soil sampling survey for trace mercury was completed on the base and surrounding land. The technique, described by McCarthy et al.,[19] uses the great volatility and mobility of mercury as an indication of subsurface temperatures. It is believed that mercury migrates upward and away from geothermal fluids which frequently have high concentrations of the element. The mercury then becomes trapped on the surface of clays and organic compounds. Thus, the soils overlying and adjacent to geothermal reservoirs or migrating thermal fluids should be enriched in mercury. The area of interest is sampled (preferably on a grid system) by taking small amounts of soil to analyze for mercury concentration. The resultant data are then plotted and contoured.

The results of the NAS Fallon mercury survey is described by Bruce (footnote 2) and shown in Figure 5. The map shows three broadly outlined anomalies of high mercury concentration which strike in the same general direction as the major structural trends. The large mercury anomaly in the southeast corner correlated well with the results of the initial thermal gradient program.

Thermal Gradient II

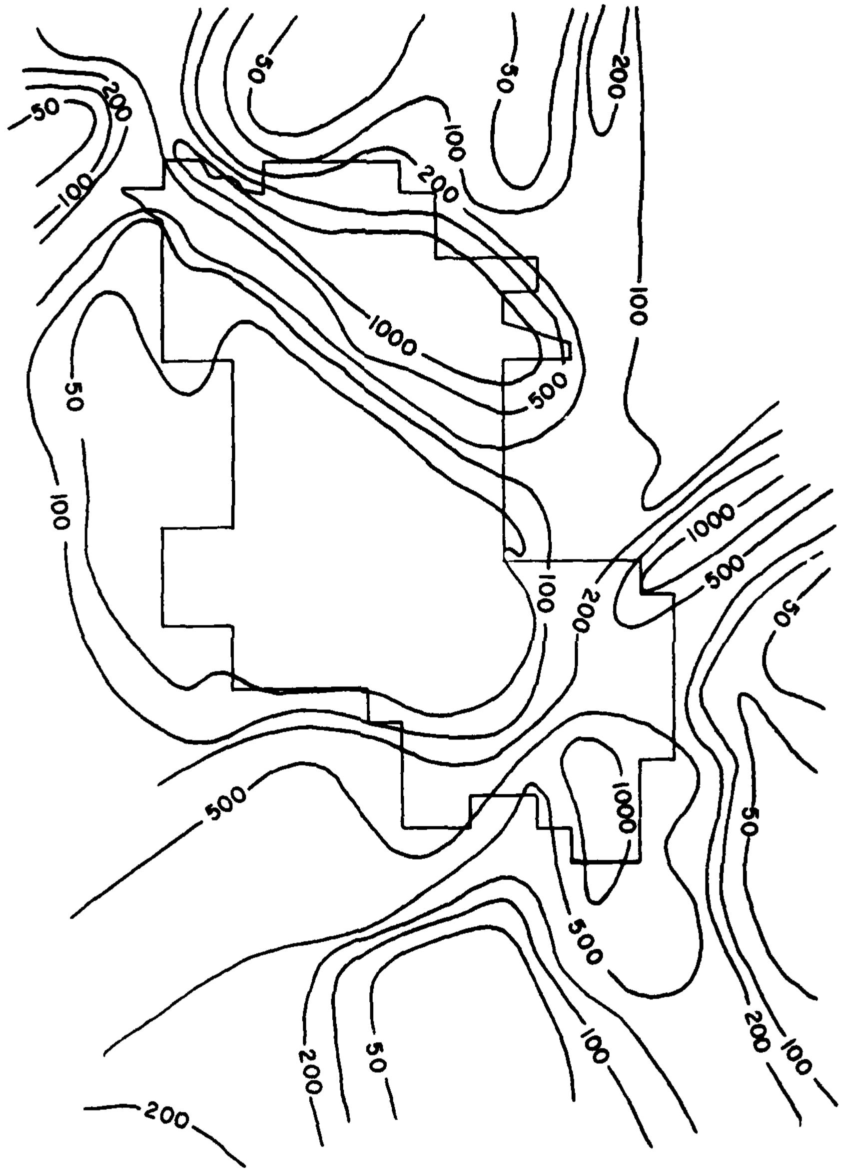
Using the results of the mercury survey, five additional thermal gradient holes were drilled on NAS Fallon (Holes 27 through 31; Figure 4 and Appendix D). Four of the holes were drilled on the northwest trending mercury anomaly in the northeast quarter of the map. The holes showed higher than normal gradients of 5.4°F/100 feet to 5.7°F/100 feet (9.8°C/100 m to 10.4°C/100 m), but were lower by a factor of two than those found on the southeast corner of the base. The fifth hole was drilled on the west central boundary of the base and had a recorded temperature gradient of 5.2°F/100 feet (9.5°C/100 m).

GEOTHERMAL EXPLORATION - THE PRESENT SURVEYS

The present phase of exploration included aeromagnetics, gravity, land magnetics, and the drilling of a 2025-foot (617-m) observation hole.

---

[19] M. H. McCarthy, W. W. Vaughn, R. E. Learned, and J. L. Menschke. "Mercury in Soil Gas and Air - A Potential Tool in Mineral Exploration." United States Geological Survey Circular 609, 1969.



Contour Interval = 50, 100, 200, 500, 1000 ppb of Mercury

FIGURE 5. Results of the Trace Mercury Study, NAS Fallon.

Aeromagnetic Survey

Aeromagnetics were flown over NAS Fallon and adjoining land as a joint venture between the Navy and the Union Oil Company. Incorporated into the venture was a request by Union that all information from the middle of NAS Fallon south be withheld from publication due to their extensive lease holdings in that area.

The survey was flown by Applied Geophysics of Salt Lake City at an elevation of 400 MTC with flight lines 1/2 mile apart in an east-west direction. The results of the survey, shown by Figure 6, indicate a large body of rock with high susceptibility in the northwest quarter of the map. This is believed to be due to the basaltic flows on and around Rattlesnake Hill. Further east, the contours become lower and looser, implying a deepening basement. To the south, including the north half of NAS Fallon, a broad, unclosed magnetic high is visible. The relative smoothness of the contours suggests an intrusion or large buried feature. This high is not believed to be due to basaltic flows. In the southeast corner of the map, the magnetic signature of the Lahontan Mountains is apparent.

Gravity Survey

The gravity survey consisted of 217 gravity stations. All stations were surveyed by a theodolite giving elevation ties which were generally better than 0.2 foot (0.06 m). The stations were then occupied by a LaCoste-Romberg gravimeter in four-hour drifts. The survey was tied to DOD Gravity Base 2351-1 at the Fallon Municipal Airport and reduced using the 1967 International Gravity Formula in the manner described by Nettleton.[20] Terrain corrections were applied through zone "M" using charts and tables published by Hammer.[21] Pertinent data on the gravity survey are presented in Appendix A.

The complete Bouguer gravity map of NAS Fallon, reduced at 2.0 gm/cc is shown by Figure 7. The broad, crescent-shaped contours which sweep from the south to the west imply a deepening basement, or a large column of low density rock, to the southwest. The gravity highs to the east and

---

[20] L. L. Nettleton. *Gravity and Magnetics in Oil Prospecting*. McGraw-Hill Company, 1976.

[21] Sigmund Hammer. "Terrain Corrections for Gravimeter Stations," *Geophysics*, Vol. 4, pp. 184-194.

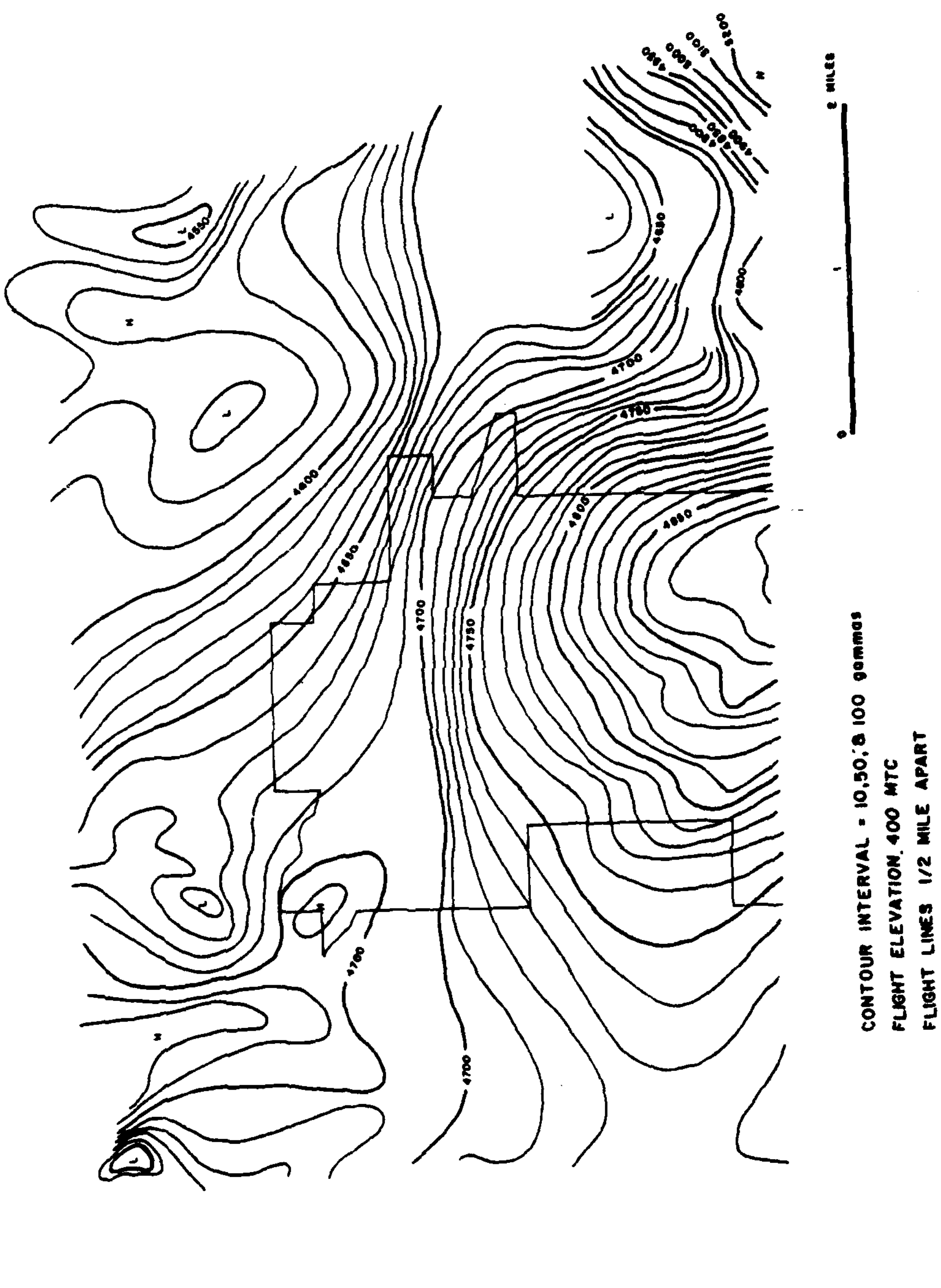


FIGURE 6. Aeromagnetic Map, Northern Half of NAS Fallon.

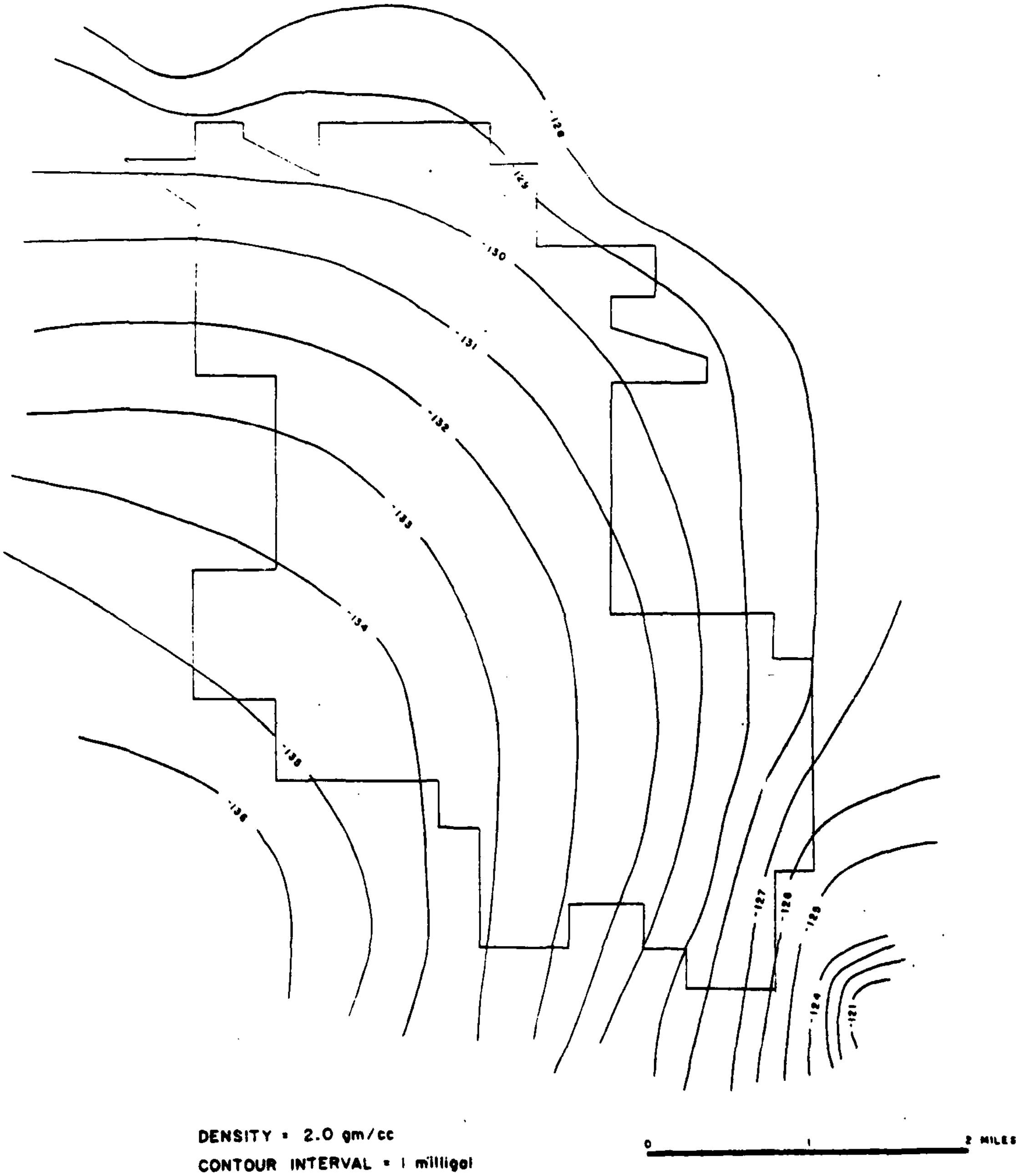


FIGURE 7. Complete Bouguer Anomaly Map, NAS Fallon.

north are thought to be due to a rise in the basement, with the Lahontan Mountains horst beginning to be visible in the east. The high to the north is probably a near-surface buried ridge.

The residual gravity map, shown by Figure 8, was compiled using a nine-point regional removal technique described by Nettleton (footnote 20) and Dobrin.[22] Grid spacing was 2,000 feet (610 m). The map shows a northward elongated, low-gravity feature in the southwest corner of the base. This feature appears to be fault controlled, and is probably a deepening of the basement. Elsewhere, the residual is subdued except for some small anomalies in the northern third of the base.

Land Magnetics Survey

The land magnetics survey used a Geometrics magnetometer, and occupied all stations coincident with the gravity study. The data were reduced using the technique described by Nettleton (footnote 20) and shown in Appendix A.

The total intensity magnetic map is shown in Figure 9. The most prominent feature on the map is the large high near the center of NAS Fallon which corresponds well with the anomaly found by aeromagnetics. The feature is probably fault defined on the south and east, and may be cut in two by a fault. A moderate magnetic low is also evident in the southeast corner; directly west of that is a moderate high which may be structurally controlled.

The residual magnetic map (Figure 10) was produced by subtracting the regional trends found on the USGS Reno Aeromagnetic Sheet (1977)[23] from the total intensity magnetic map (Figure 9). The residual map shows a broadened low in the southeast corner and a somewhat smoother high in the center of the base. In addition, an enclosed low in the northeast becomes apparent. It is interesting to note that unlike the feature on the residual gravity map, the low in the southeast does not extend clear through the eastern portion of the base. A bridge extending eastward from the central magnetic high may imply a small upwarp in the basement.

Observation Hole

The most recent step of the Navy's geothermal exploration program at NAS Fallon was the drilling of a 2,025-foot (617-m) observation hole in

---

[22] Milton B. Dobrin. *Introduction to Geophysical Prospecting*. McGraw-Hill Company, 1976.

[23] United States Geological Survey. "Aeromagnetic Map of Nevada - Reno Sheet." Nevada Bureau of Mines and Geology, Map 54, 1977.

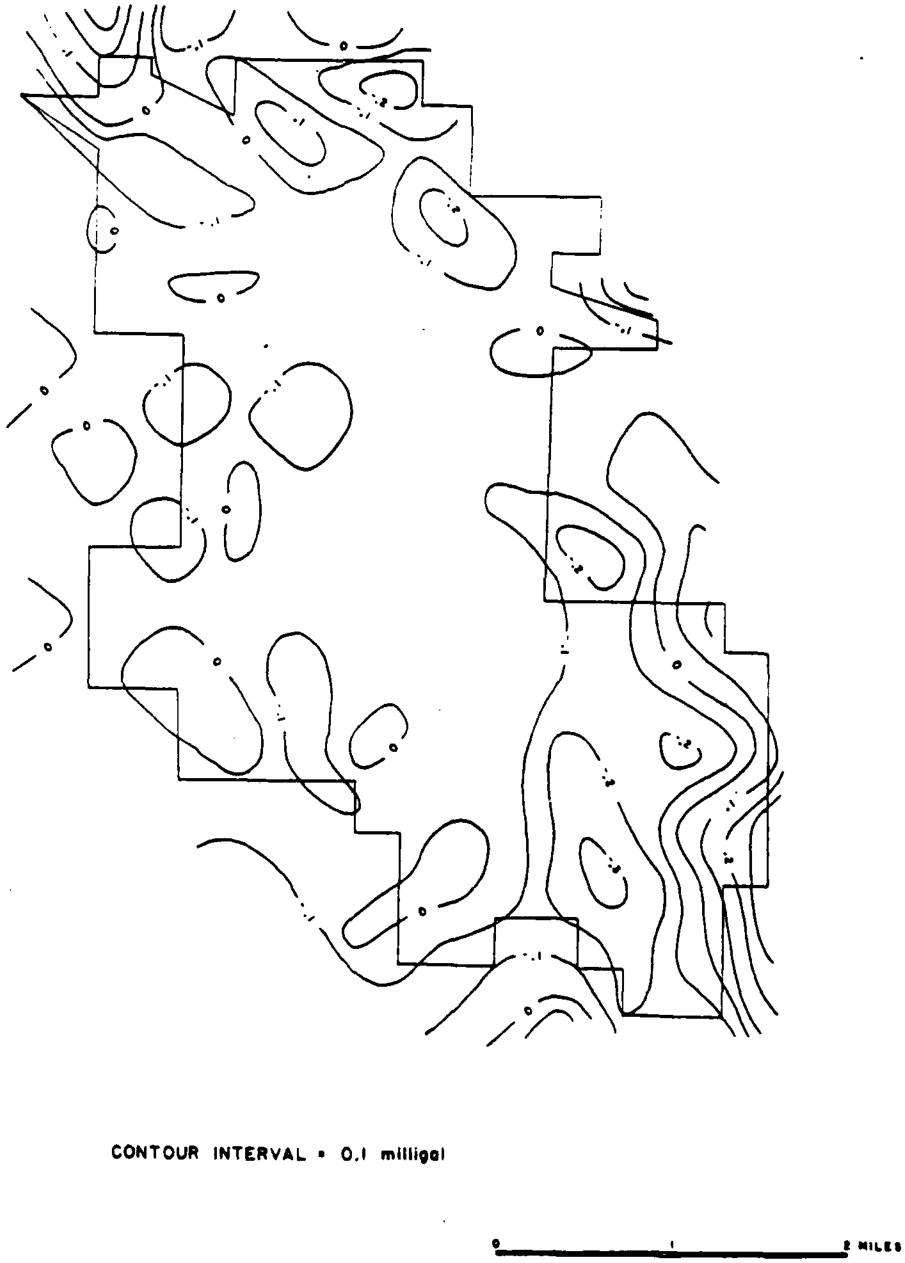
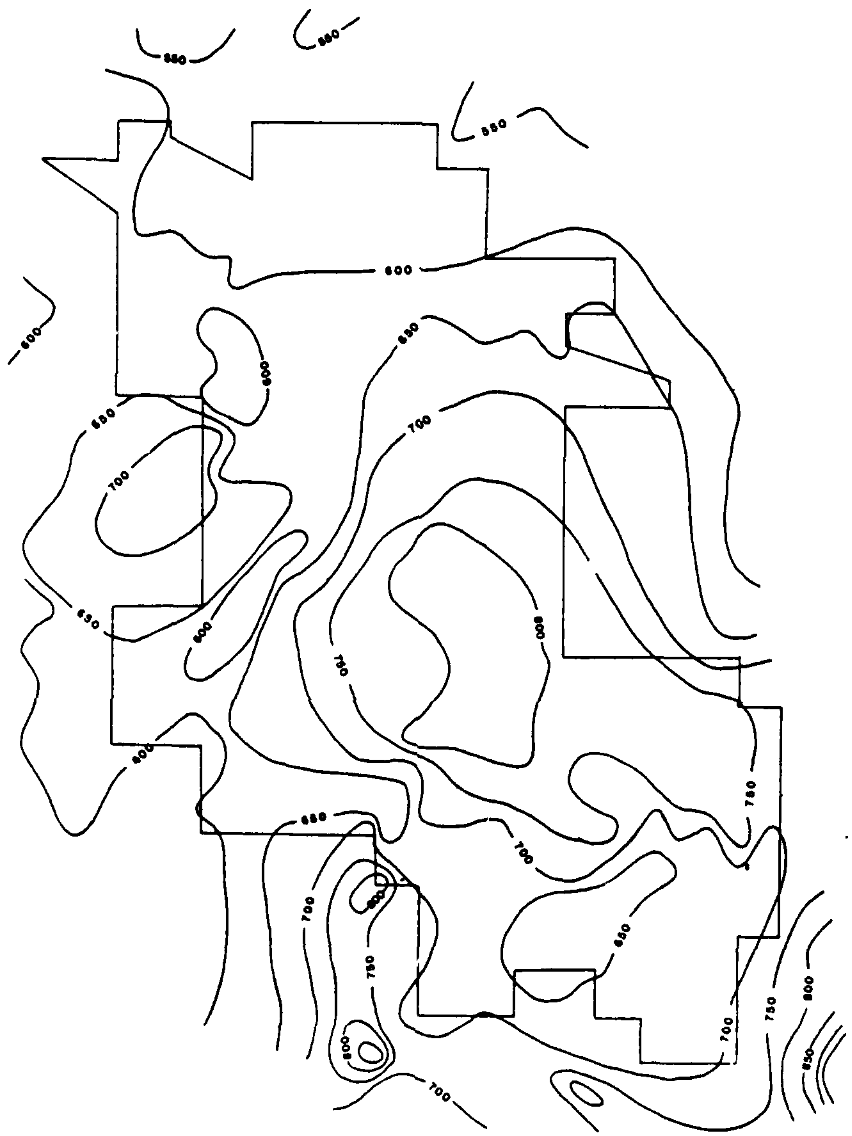


FIGURE 8. Residual Gravity Map, NAS Fallon.



CONTOUR INTERVAL = 50 gammas
ALL VALUES + 52,000 gammas

0 1 2 MILES

FIGURE 9. Total Intensity Land Magnetic Map, NAS Fallon.

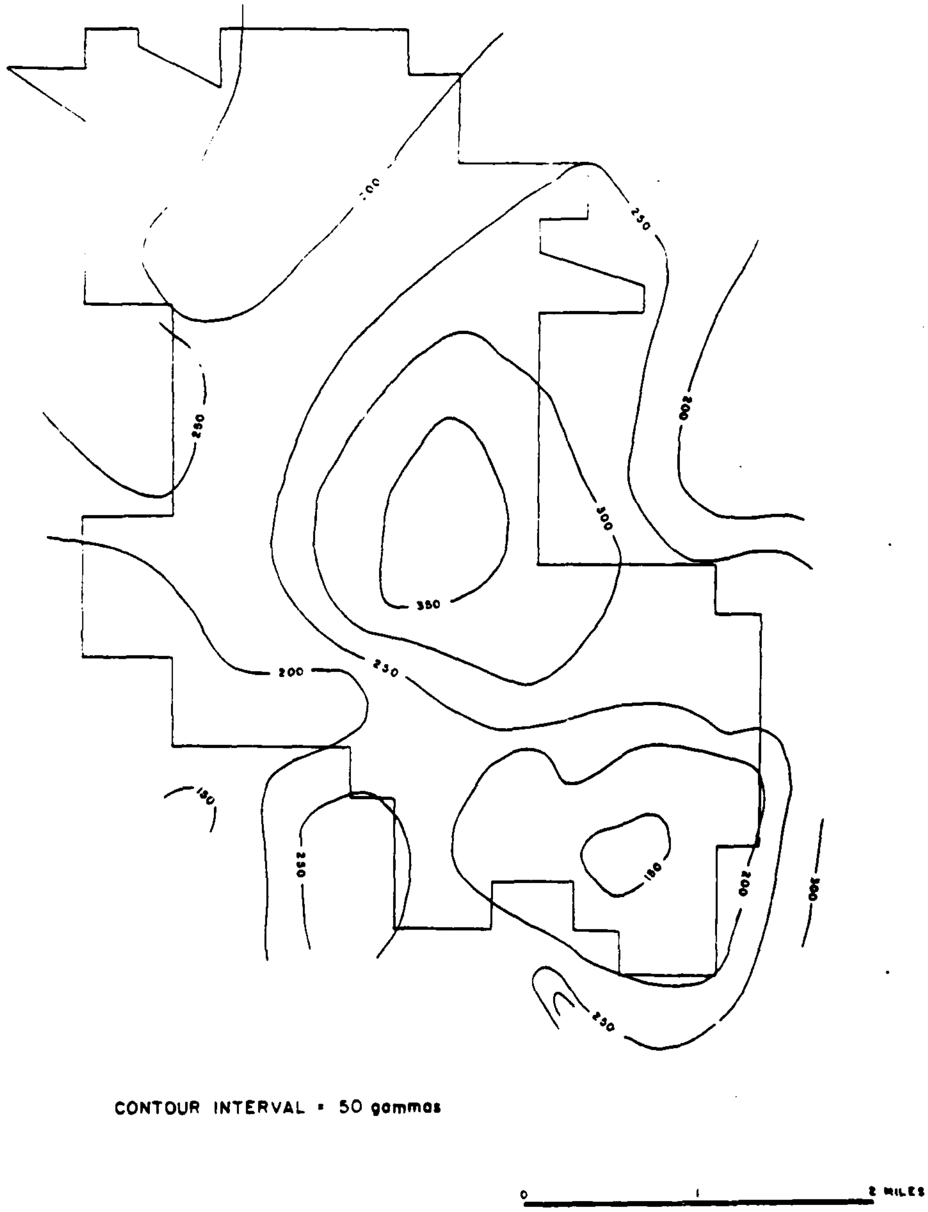


FIGURE 10. Residual Magnetic Map, NAS Fallon.

the southeast corner of the northeast quarter of the northeast quarter (NE 1/4 NE 1/4) of Section 36 (Figure 4). The well was drilled through unconsolidated sediments to a depth of 950 feet (290 m) where a 300-foot (91-m) zone of pyrite and hydrothermal alteration was encountered. From 1,250 feet (381 m) to 1,800 feet (549 m) the rock type was again unconsolidated sediments. Then, from 1,800 feet (549 m) to total depth of 2,025 feet (617 m), the rock was rhyolitic and may correspond to the capping basalt unit described by Hastings (footnote 10).

Upon thermal stabilization of the country rock, a bottom hole temperature of 206°F (96.67°C) was recorded. This gives a thermal gradient of 7.56°F/100 feet (13.6°C/100 m). It should be noted that the temperature curve goes isometric between the depth of 1,050 to 1,200 feet (320 to 366 m) with a nearly constant temperature of 158°F (70°C). It is not known whether this is due to cold water mixing or hot artesian water rising along a fracture zone, but this depth does correspond to the zone of hydrothermal alteration mentioned above. A complete temperature versus depth curve is given in Appendix D.

SYNTHESIS AND GEOLOGIC INTERPRETATION

The brief interpretations given in the previous sections are intended to give a rough, but reasonable model of the subsurface geology using solely the results of separate geological, geophysical, and geochemical field investigations. However, when the data from different investigative methods are compared, further refinements in the interpretation can be made. Overlapping anomalies tend to remove some of the ambiguities inherent when trying to explain subsurface features with only one investigative method. Overlapping data also adds confidence that the subsurface is at least beginning to be understood. With this in mind, the following observations can be made of the geologic structures underlying NAS Fallon (Figure 11).

1. The aeromagnetic, land magnetic, and mercury data all indicate a structurally controlled feature near the center of NAS Fallon. The magnetic maps suggest the feature could be a westward extension of the Lahontan Mountains or a cooled intrusion possibly emplaced during the volcanic episodes which created Rattlesnake Hill or the Soda Lake Craters. The mercury study outlines the feature as a low, bounded on three sides by elongated highs which parallel the three major structural trends of the area. Residual gravity indicates the structure is truncated to the east (see below) and, due to the subdued gravity signature, is probably planar in nature. Examination of well logs taken at Well 0 (footnote 15) indicated that this feature is at least 1,800 feet (549 m) deep, while calculations of sedimentary cover using the half-slope method on the aeromagnetic data as described by Nettleton (footnote 20) show a depth in excess of 3,000 feet (914 m).

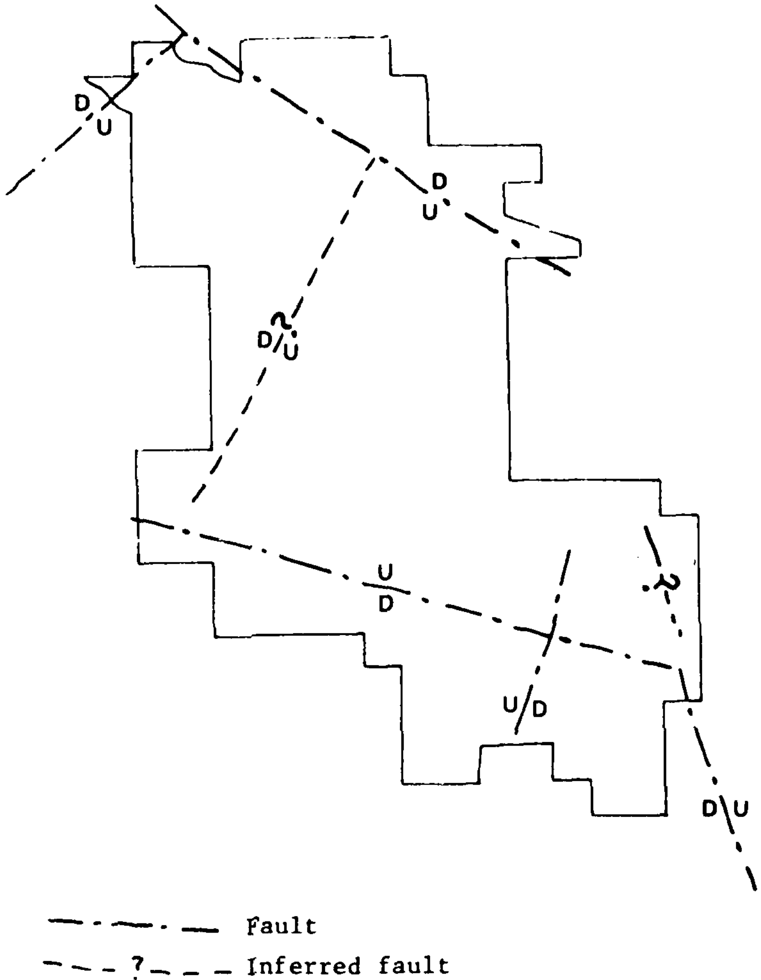


FIGURE 11. Interpretation Map, Possible Fault Locations, NAS Fallon.

2. Directly east of the above feature a narrow, northward elongated structure was delineated by a residual gravity low, mercury high, and a moderate magnetic low. The gravity suggests a downdropped basement, perhaps forming a mini-graben between the uplifted rocks of the Lahontan Mountains and the structure described in paragraph 1 above. The deepest portion of the feature probably exists beneath the extreme southeast corner of the base as evidenced by the lowest residual gravity values and corresponding magnetic low. In this area, the highest thermal gradients found to date on NAS Fallon were recorded, and a 2,025-foot (617-m) observation hole recorded temperatures in excess of 200°F at 2,000 feet (93.3°C at 610 m). From this it is thought that the high mercury anomaly,

which coincides almost exactly over the residual gravity high, is due to the presence of geothermal fluids at depth migrating along fracture systems in the basement and the sediments of the mini-graben. The extent of the mini-graben was not delineated, but the mercury, magnetics, and gravity data indicate that it may extend to both the north and south.

3. Elsewhere on NAS Fallon, the structural trends are not as obvious. The prominent northwest trending mercury high in the northern half of the base corresponds only slightly with a residual gravity trend, and shows almost no correlation with the magnetic maps. Thermal gradient holes drilled on this mercury high recorded higher than normal temperatures, but the gradients were lower by a factor of two than those found in the southeast corner of the base. As a guess, perhaps the geothermal fluids described in paragraph 2 are migrating north and west along small faults defining the feature in paragraph 1. However, further work would be needed to rule out productive geothermal potential in this area.

The present surveys were not extended far enough south to further explain the large mercury high located south of NAS Fallon. However, the anomaly does appear to be structurally controlled.

GEOTHERMAL TARGET

NAS Fallon has one primary geothermal target and one secondary.

The primary target is located in the southeast corner of the base on the Navy-controlled land in sections 36, 25, and to some extent 24 (see Figure 4). This area is characterized by low residual gravity, low magnetics, high mercury concentrations, and high thermal gradients, A 2025-foot (617-m) observation hole, drilled in the extreme southeast corner, implies that temperatures as great as 300°F (149°C) may exist at a 3500-foot (1067-m) depth. However, the source of the heat is not known. It is possible that the geothermal water is migrating westward along fractures from the nearby Saltwells Basin, or perhaps from a separate system all together. Further work is suggested including the drilling of an observation hole that is known to penetrate basement. This would indicate if the high temperatures are only in the sediments or rising from sources within the basement.

The secondary target lies in and along the northern boundary of section 11 within the high mercury anomaly shown in Figure 5. The anomaly has higher than normal thermal gradients that are now thought to be strictly associated with shallow migrating thermal water. A 2,000-foot (610-m) hole in this area would give deep gradient information.

SITE STUDIES OF RANGE BRAVO 16

INTRODUCTION

Range Bravo 16 is an air-to-ground bombing range located nearly 12 miles (19 km) west-southwest of NAS Fallon (see Figures 1 and 12). The range lies partially in the Dead Camel Mountains, but the greatest portion lies to the east in smooth alkali flats. It comprises 27 square miles (43 km^2) of land.

The Dead Camel Mountains parallel the northwest striking Walker Lane Trend and define the southwestern boundary of the Carson Desert. The mountains are composed of Miocene rhyolitic tuffs overlain by andesitic tuffs and flow breccias. Both units are overlain unconformably by basalt and andesite flows which are interlayered with sedimentary rock (footnote 12). Structurally, the Dead Camel Mountains are cut by northeast trending, high-angle faults. Other faults are believed to be obscured by the lack of marker horizons in the basalts. Evidence of a large, synclinal fold was observed by Axelrod[24] north of Range Bravo 16.

The alkali flats are composed of unconsolidated Quaternary sediments, with a description given by Bruce (footnote 2). Most of the sedimentary rock is sand and gravel with some silt and clay. The flats are cut by several faults which are believed associated with the Wildcat Fault Zone.

GEOTHERMAL EXPLORATION - PREVIOUS STUDIES

Mercury Soil Sampling

Geothermal exploration on Range Bravo 16 was initiated by mercury soil sampling. The results, shown in Figure 13, showed small, almost random anomalies of mercury, none of which exhibited the large concentrations found at NAS Fallon. It is thought that the lack of clays and organic compounds in the soil on Bravo 16 contributed to the small concentrations. Sands and gravels do not effectively retain mercury.

Thermal Gradient

In another attempt to delineate subsurface temperatures, seven thermal gradient holes were drilled on Range Bravo 16 (Holes 32 through 38; Figure 12 and Appendix D). The resultant gradients ranged from about 4.2°F/100 feet (7.7°C/100 m) to 5.4°F/100 feet (9.8°C/100 m), well above

---

[24] D. I. Axelrod. "Mio-Pliocene Floras From West-Central Nevada." *California Univ. Pub. Geol. Sci.*, Vol. 33, pp. 1-321.

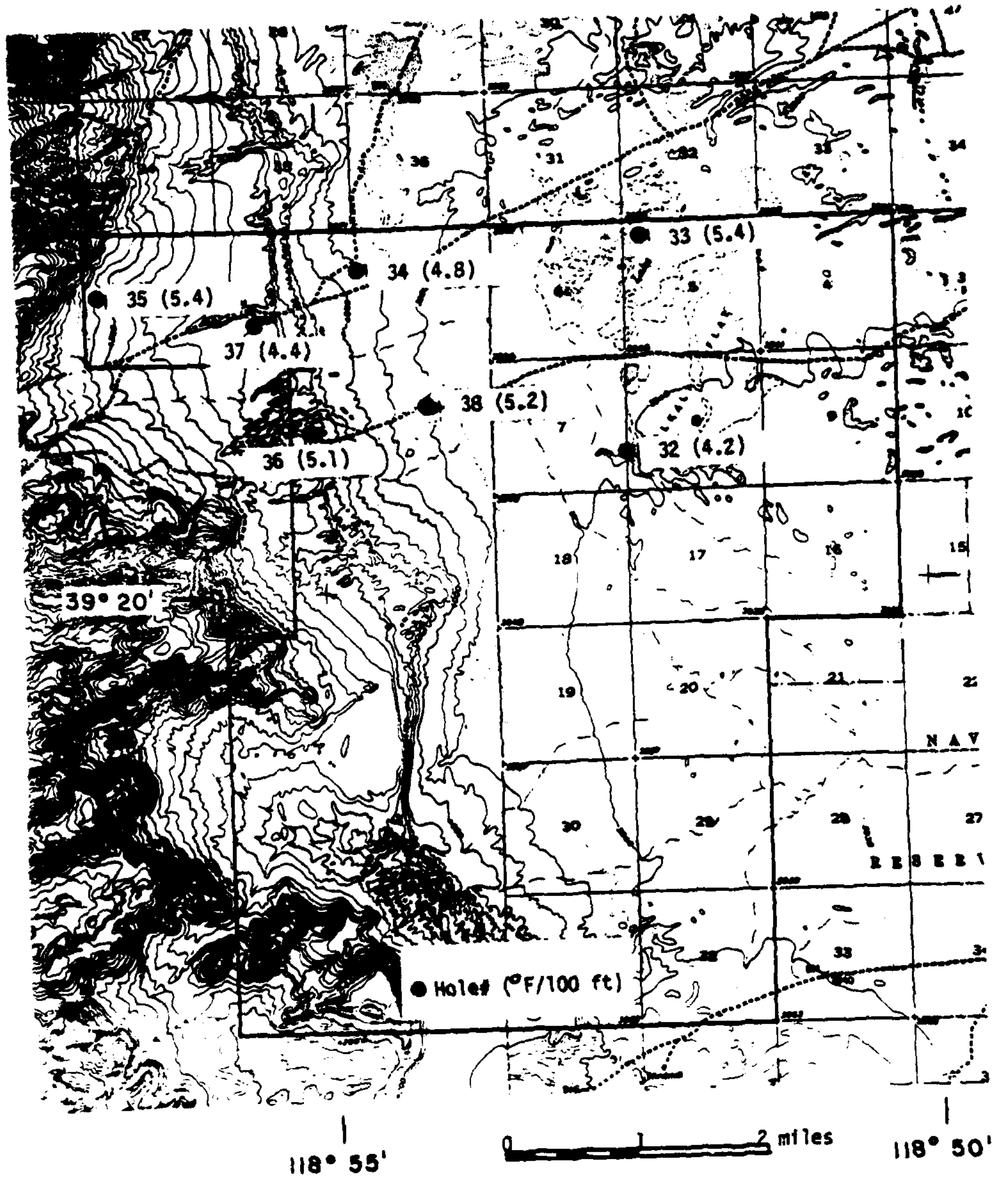


FIGURE 12. Bravo 16 Topographic Map Showing Therma Gradient Holes.

Contour Interval = 10 ppb of Mercury

FIGURE 13. Results of the Trace Mercury Study, Bravo 16.

the Basin and Range average of 1.65 to 2.75°F/100 feet (3 to 5°C/100 m), but half as much as those found at the southeast corner of NAS Fallon.

GEOTHERMAL EXPLORATION - THE PRESENT SURVEYS

The present phase of exploration includes gravity and land magnetics in an attempt to define structural trends of the area.

Gravity Survey

The gravity survey consisted of 212 stations. Data gathering and reduction are exactly as described for NAS Fallon. The principal facts concerning this survey are listed in Appendix B.

Figure 14 is the complete Bouguer anomaly map of Bravo 16 reduced with a density of 2.4 gm/cc. The map shows a large northwest trending gravity high in the southern half of Range Bravo 16 which parallels the Dead Camel Mountains. Elsewhere, strong gradients in the east imply strong structural trends which appear to shift from the northwest in the center of Bravo 16 to more northerly in the northeast quarter of the map.

The residual gravity map is shown in Figure 15, which was computed using the nine-point regional removal described in the NAS Fallon section. This map sharpens the high in the southern half of the range, showing it to be elongated and probably fault controlled. This is believed to be a buried, eastern extension of the Dead Camel Mountains. To the northeast, the basement below the alkali flats is characterized by numerous north trending highs and lows. This would tend to indicate a complex pattern of block faulting, possibly due to the intersection of the Wildcat Fault Zone and the northwest striking Walker Lane Trend.

Land Magnetics Survey

The land magnetics survey was performed coincident with the gravity survey and occupied the same stations. The data were reduced as described before, and presented in Appendix B.

The Total Intensity Magnetic Map for Bravo 16 is shown in Figure 16. Like the complete Bouguer gravity map (Figure 14), it shows a large northwest striking feature in the southern half of the Range. To the north, the complex structural features of the basement are again visible. The features are also seen on the residual magnetic map (Figure 17) which was created by the subtraction of the regional magnetics on the Reno aeromagnetic map from Figure 16.

SYNTHESIS AND GEOLOGIC INTERPRETATION

Of the four explanation techniques used on Bravo 16--thermal gradient holes, mercury concentration study, gravity, and land magnetics--only the gravity and magnetic data show any correlation when overlain. They indicate that the southern half of Bravo 16 is underlain by a doming or upwarp of the basement. This feature trends northwest, paralleling the Dead Camel Mountains in a manner which suggests a buried eastward extension of the range. To the north of the feature, both methods indicate the structural complexity of the basement beneath the alkali flats thought to be due to the intersection of the Wildcat Fault Zone and the Walker Lane Trend. The presence of the Wildcat Fault Zone is seen by the north trending contours on the residual gravity map and on both magnetic maps (Figure 18).

Because all holes were drilled in the northern half of Bravo 16, the thermal gradient data must be considered incomplete, and any

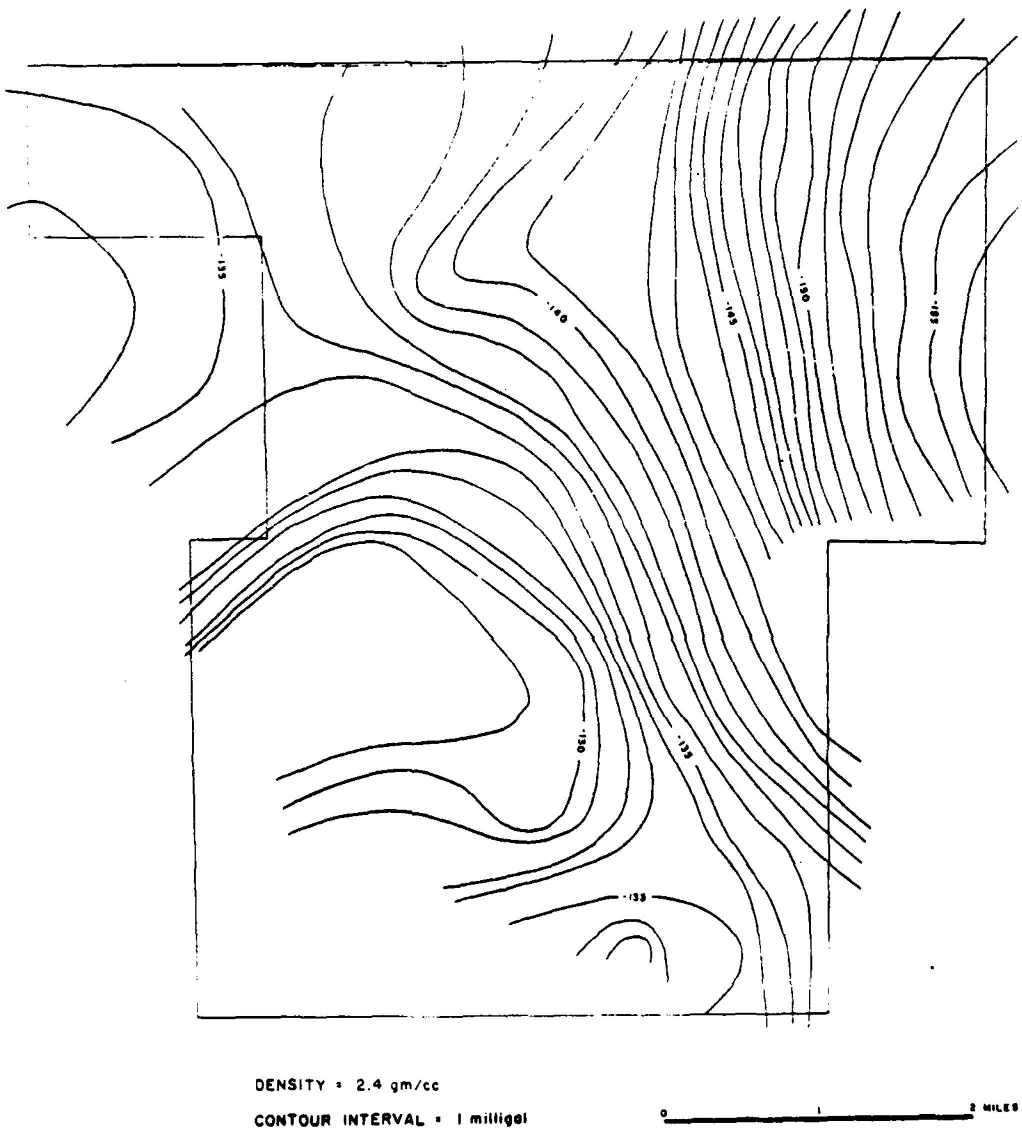
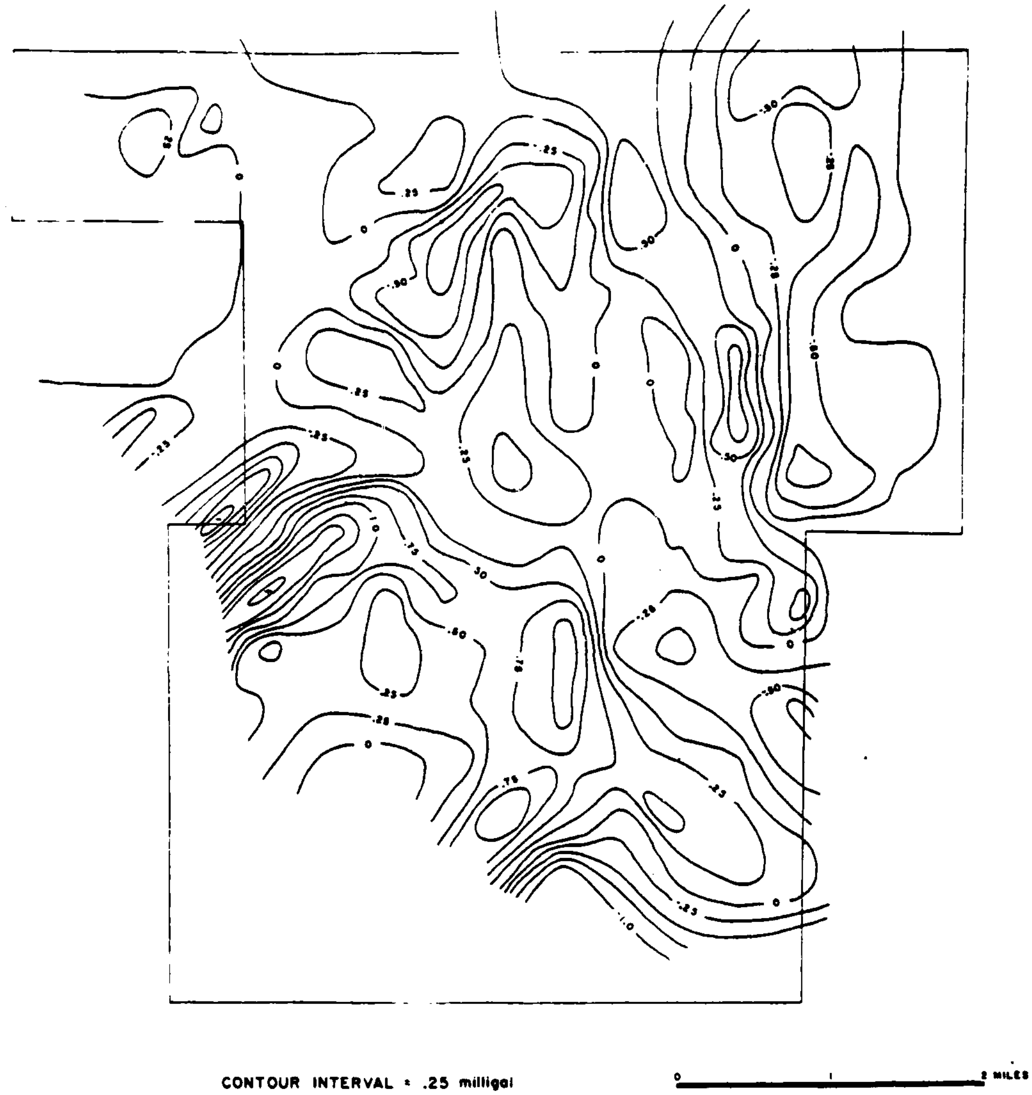


FIGURE 14. Complete Bouguer Anomaly Map, Bravo 16.



CONTOUR INTERVAL = .25 milligal

FIGURE 15. Residual Gravity Map, Bravo 16.

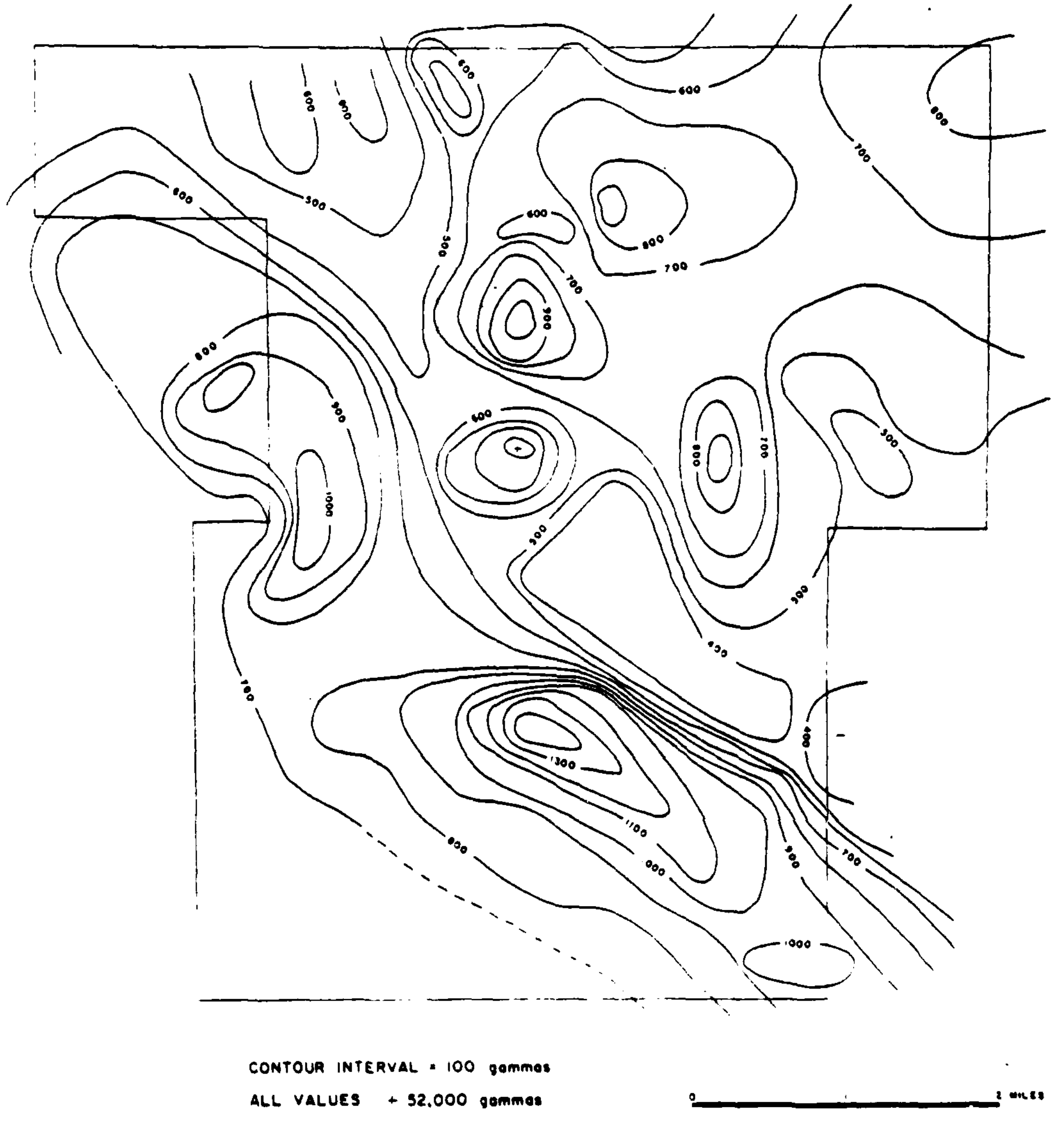


FIGURE 16. Total Intensity Land Magnetic Map, Bravo 16.

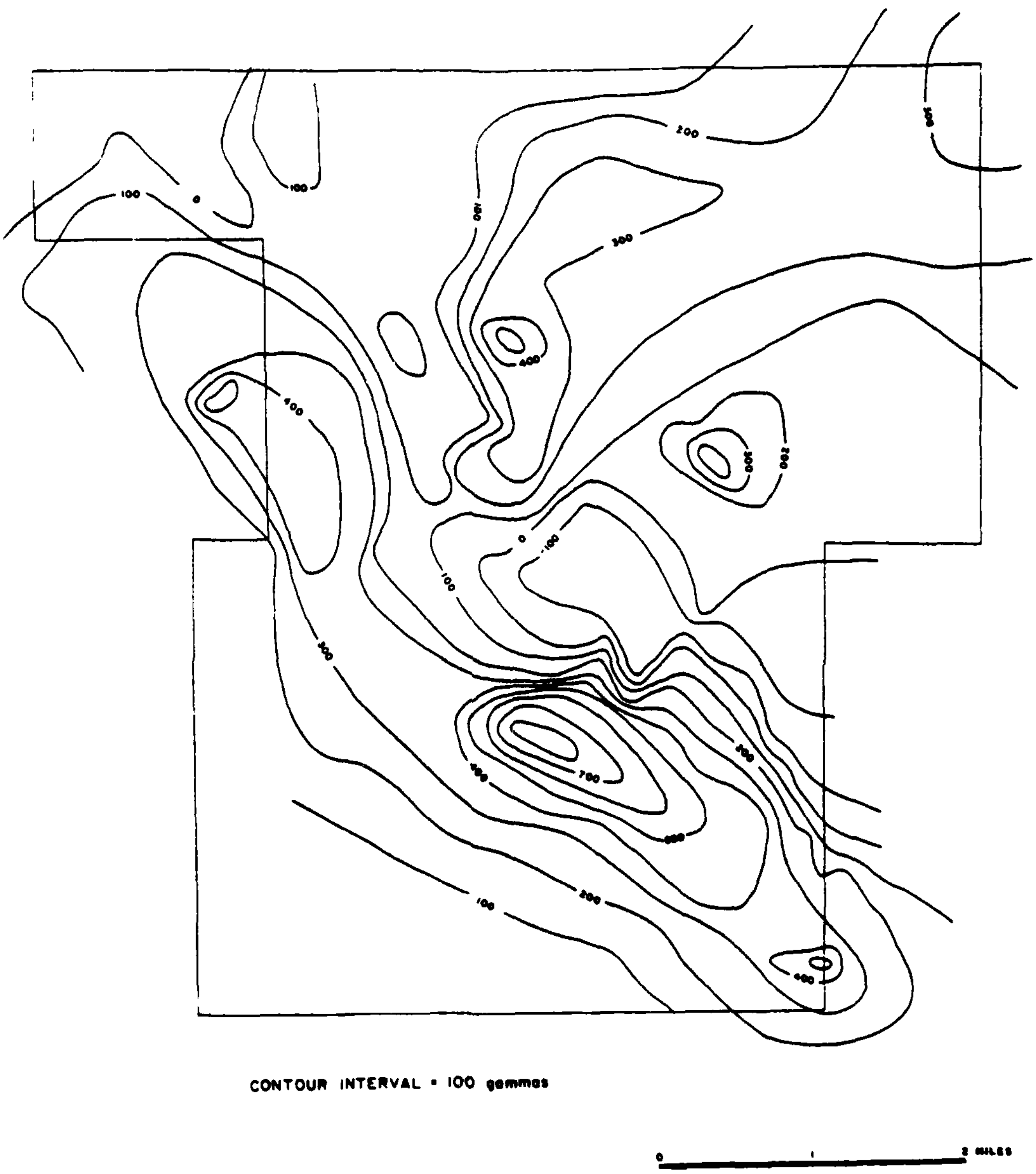


FIGURE 17. Residual Magnetic Map, Bravo 16.

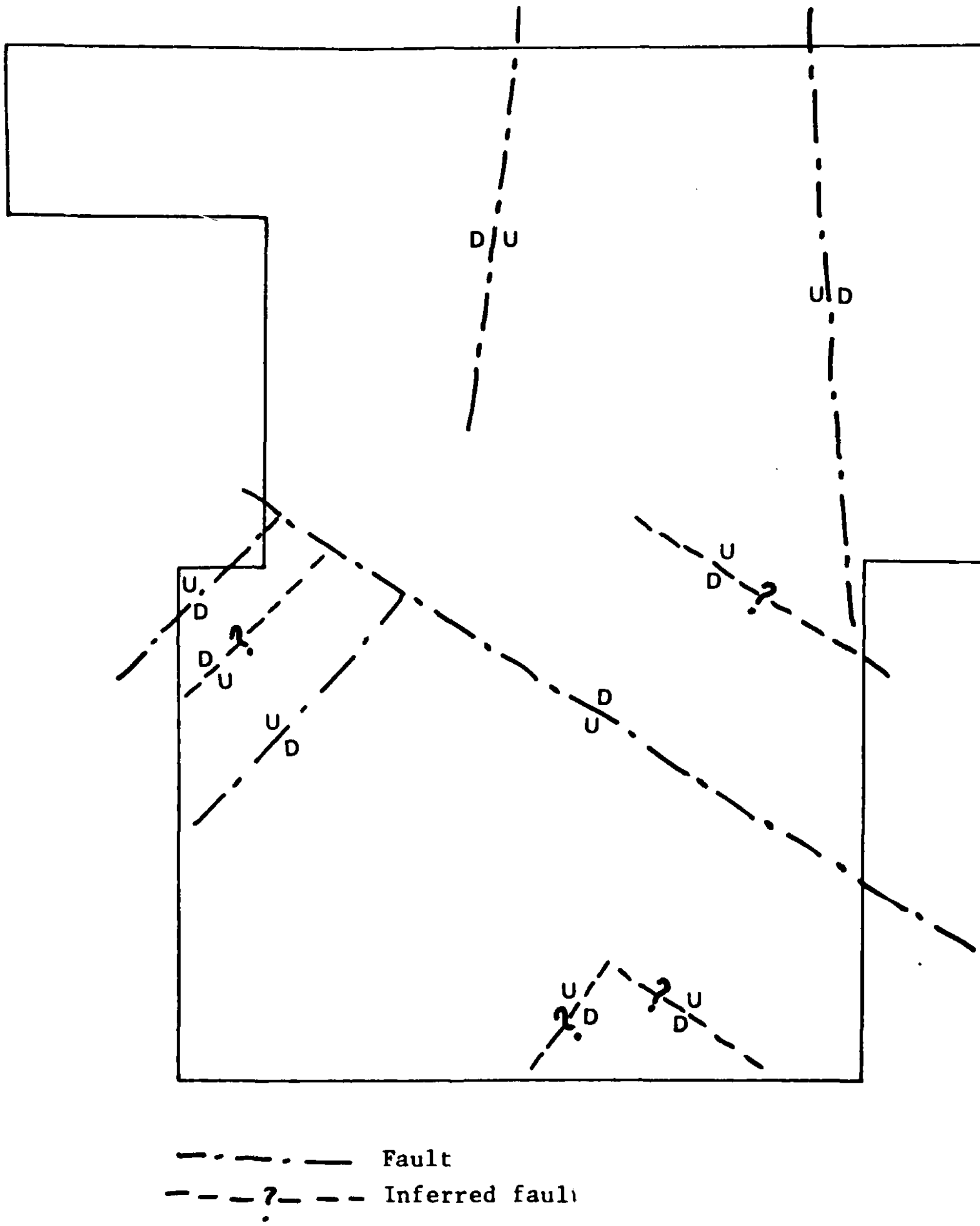


FIGURE 18. Interpretation Map, Possible Fault Locations, Bravo 16.

interpretation is difficult. There is some indication, however, that the temperature isotherms trend in a northwest direction and parallel the Dead Camel Mountains to some extent.

The mercury survey did not correlate with any of the other three studies. Due to the sandy soil type, mercury sampling is believed to be an ambiguous exploration method on Bravo 16.

GEOTHERMAL TARGET

With the information currently on hand for Range Bravo 16, a primary target for geothermal production cannot be given, but one area can be recommended for further exploration work, as explained below:

There is no surface manifestation of geothermal activity on Baker 16. The nearest thermal springs are located nearly 10 miles (16 km) o the southeast at Lee Hot Springs (see Figure 19). These springs lie to the north of the Blow Sand Mountains which appear to be structurally controlled by the northwest striking Walker Lane Trend. The Trend also defines the front of the Dead Camel Mountains, and parallels the buried feature delineated by the gravity and magnetic surveys in the southern half of Range Bravo 16. It seems possible that thermal waters are migrating along the Trend and may exist beneath the surface near the center of the bombing range. A likely site for continued work--by both electrical resistivity to further define structure and by thermal gradient drilling to test subsurface temperatures--is in sections 19 and 20. In this area both the gravity and magnetic data indicate a structually controlled deepening of the basement which may contain thermal fluids.

SITE STUDIES OF RANGE BRAVO 19

INTRODUCTION

Range Bravo 19 is also an air-to-ground bombing range, occupying 28 square miles (45 km^2) nearly 18 miles (29 km) south of NAS Fallon. The Range lies partially in the Blow Sand Mountains and partially in the northwest section of Rawhide Flats.

The Blow Sand Mountains are composed largely of Tertiary basaltic rock with exposures of pre-Tertiary marble, granodiorite, and quartz diorite (footnote 12).

Rawhide Flats is composed of unconsolidated Quaternary sediments which range anywhere from alluvial fan deposits to fine silts and clays. The surface of the Flats occupied by Bravo 19 consists of evaporative playa deposits.

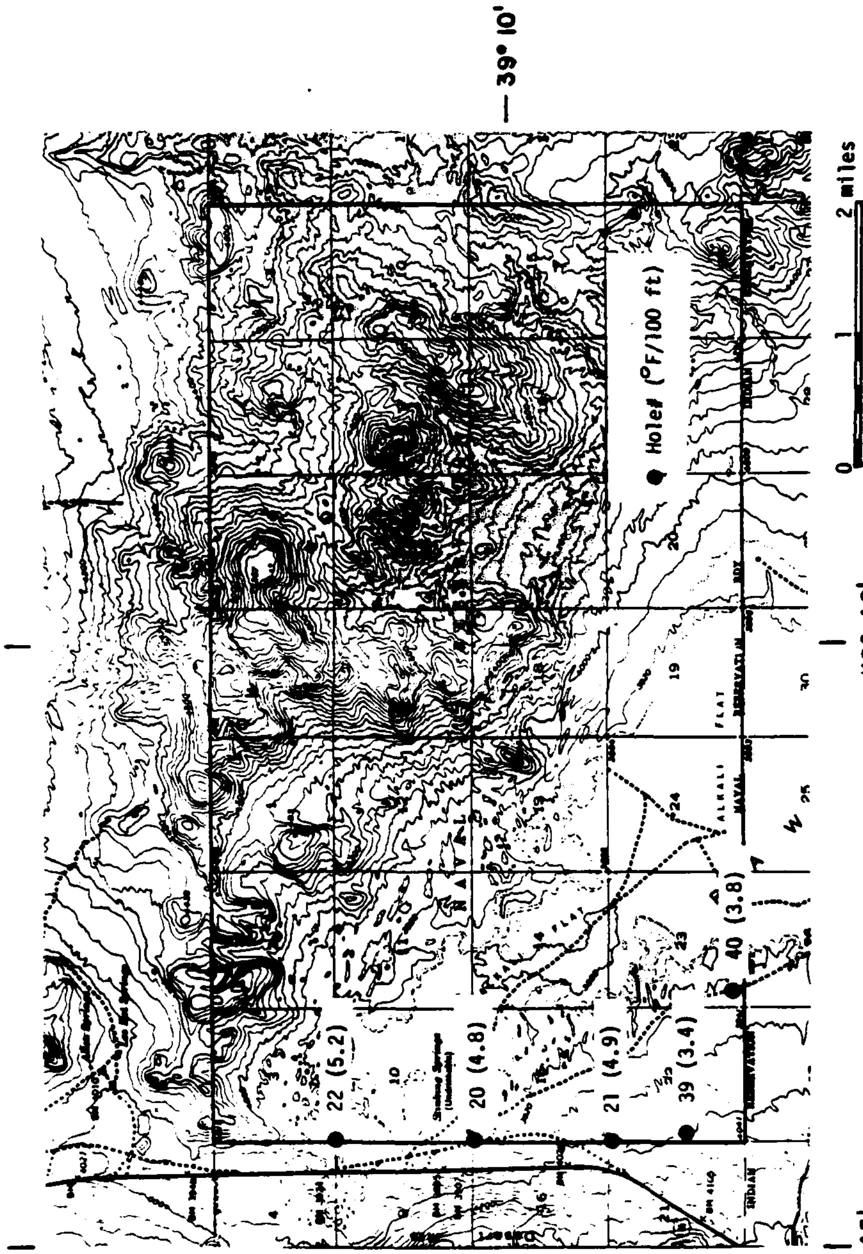


FIGURE 19. Bravo 19 Topographic Map Showing Thermal Gradient Holes.

Everywhere on Range Bravo 19 the older rocks are covered by wind-blown sand. The sand ranges from a few inches on the playa and western side of the Range to large dunes (small mountains) on the eastern half. The sand restricts vehicular travel, which explains why only half of Range Bravo 19 was surveyed in the field investigations.

Little is known about the structure of Range Bravo 19 or the surrounding area. Willden and Speed (footnote 12) indicate that high-angle faults offset the volcanic (basaltic) units, but do not discuss the amount or direction of offset.

GEOTHERMAL EXPLORATION - PREVIOUS STUDIES

Mercury Soil Sampling

As on Range Bravo 16, the initial exploration technique used on Range Bravo 19 was mercury soil sampling. The results are plotted in Figure 20, and show small anomalies of very low mercury concentrations

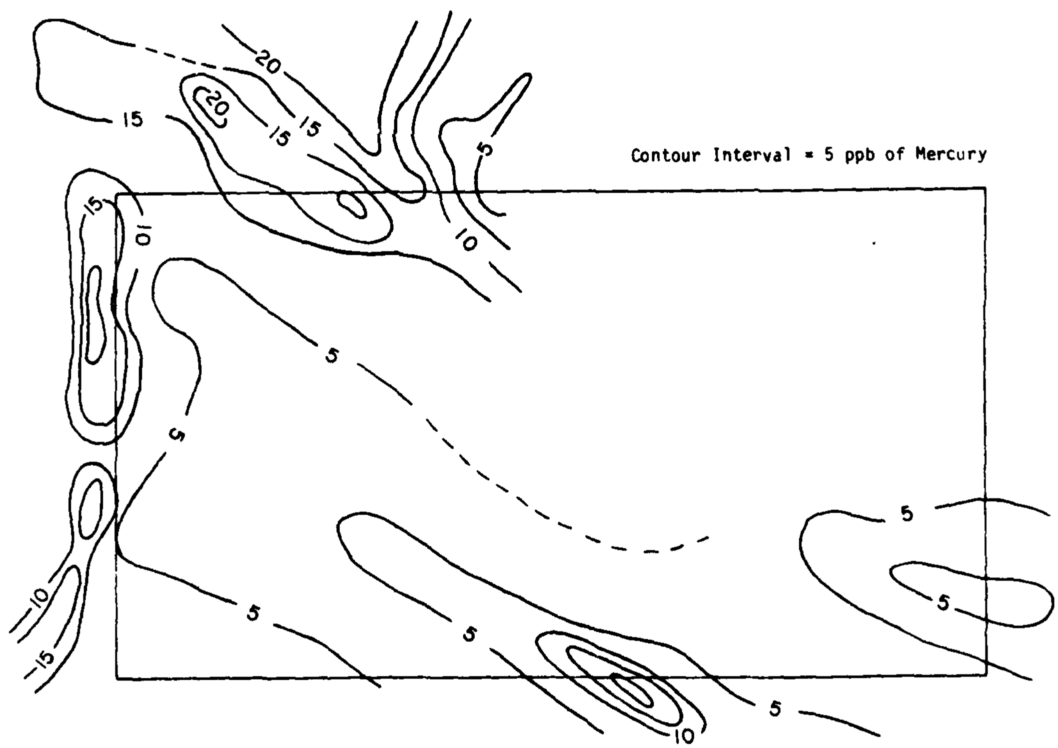


FIGURE 20. Results of the Trace Mercury Study, Bravo 19.

located generally to the north and west of the range. However, the low concentrations were expected due to the large quantities of sand in the soil.

Thermal Gradient

In order to test the subsurface temperatures, five thermal gradient holes were drilled along the south and western boundaries of Range Bravo 19 (Holes 20, 21, 22, 39, and 40; Figure 19 and Appendix D). The holes were not sited by the mercury data and were not located on any known geothermal anomaly. The results showed gradients varied from 3.4°F/100 feet (6.2°C/100 m) in the southwest corner to over 5.2°F/100 feet (9.4°C/100 m) near the northwest corner.

GEOTHERMAL EXPLORATION - THE PRESENT SURVEYS

As on Range Bravo 16, the present surveys consist of gravity and land magnetics.

Gravity

The gravity survey consisted of 159 stations. Data gathering and reduction are as described for NAS Fallon. The principal facts concerning the survey are listed in Appendix C.

The complete Bouguer anomaly map of Bravo 19, reduced at a density of 2.40 gm/cc, is shown in Figure 21. The map shows a large gravity gradient, increasing from the south to the north and trending in a northwest direction. This indicates that the southern Blow Sand Mountains are defined by a large fault, striking in the same direction as the Walker Lane Trend. The unclosed gravity low on the southern boundary is believed due to the dropping basement and corresponding column of low-density sediments of Rawhide Flats.

The residual gravity map, represented by Figure 22, implies that the Blow Sand Mountains are defined by at least two northwest trending faults located about one mile apart. Also, a north-striking feature becomes apparent in the southwest corner which may be the eastern extension of the Desert Mountains horst.

Land Magnetics

The land magnetic data taken with the gravity survey are not shown. Values recorded in basalts of the Blow Sand Mountains tended to vary thousands of gammas in 1,000 feet (305 m) of horizontal distance, causing a very busy map and an ambiguous interpretation. However, these data do

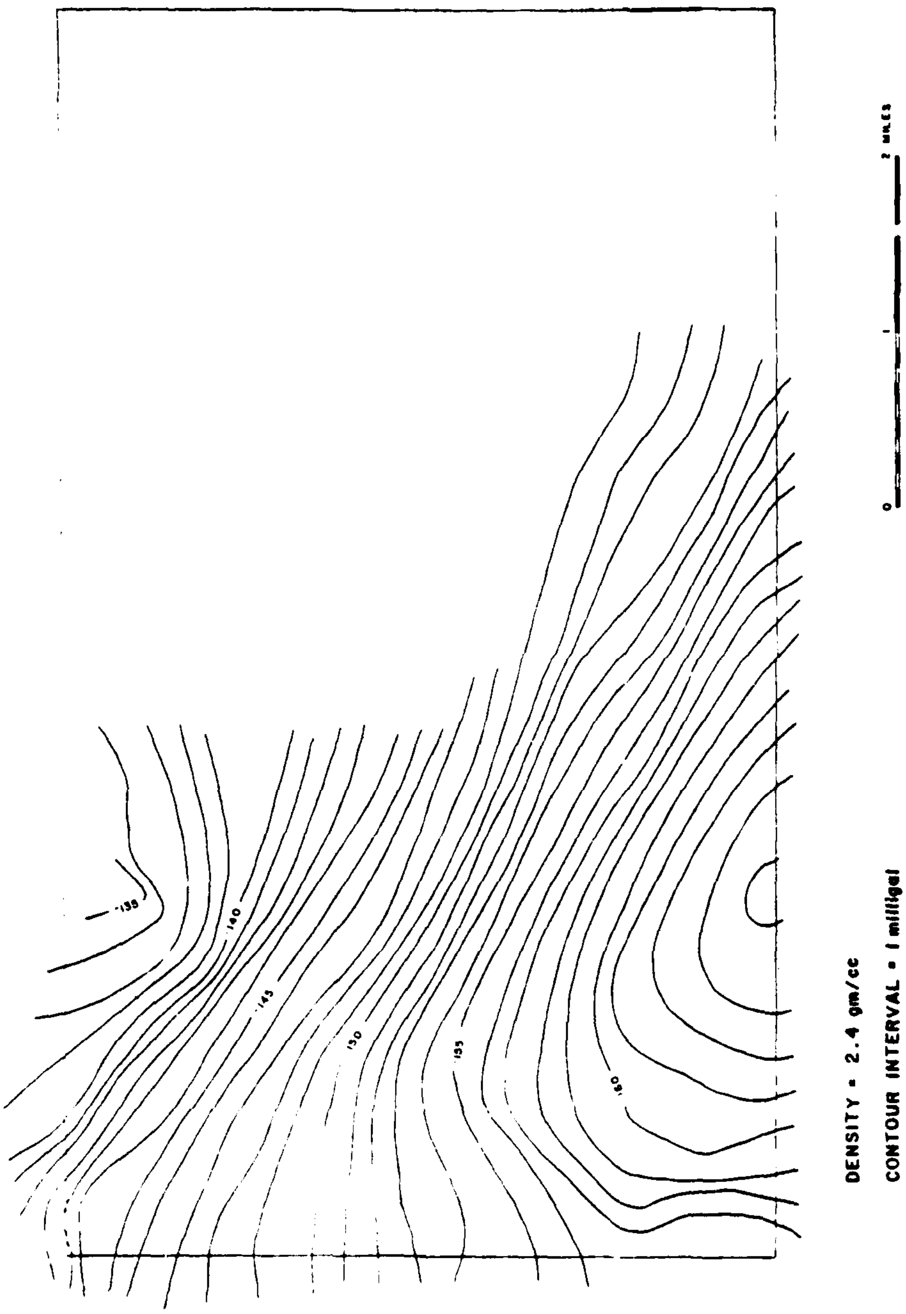


FIGURE 21. Complete Bouguer Anomaly Map, Bravo 19.

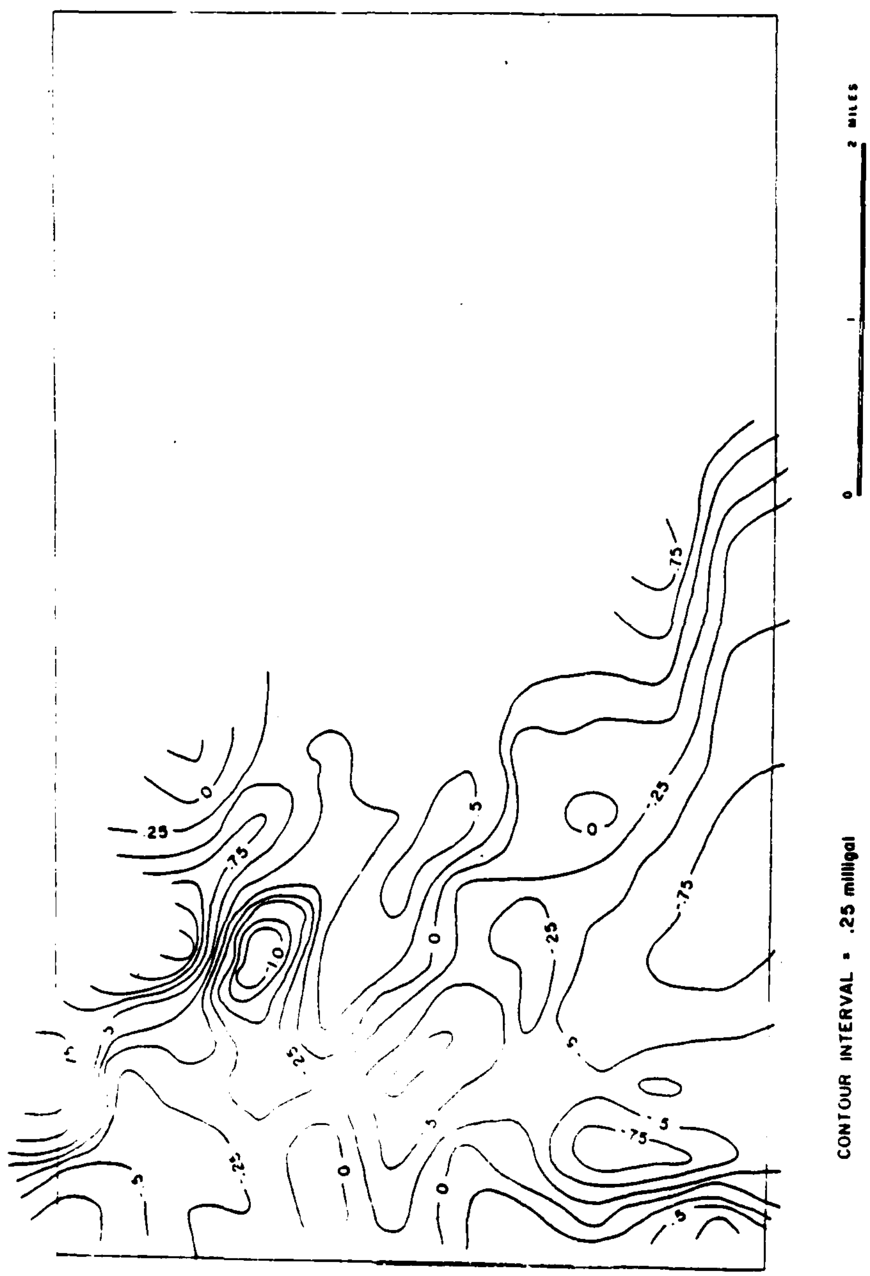


FIGURE 22. Residual Gravity Map, Bravo 19.

show the deepening basement beneath Rawhide Flats, and in the southwest the rising magnetic signature of the Desert Mountains is visible.

The data are listed in Appendix C.

SYNTHESIS AND GEOLOGIC INTERPRETATION

Due to the very low mercury concentrations and the ambiguity of most of the magnetic data, most of the geologic interpretation must come from the gravity and thermal gradient drilling (Figure 23).

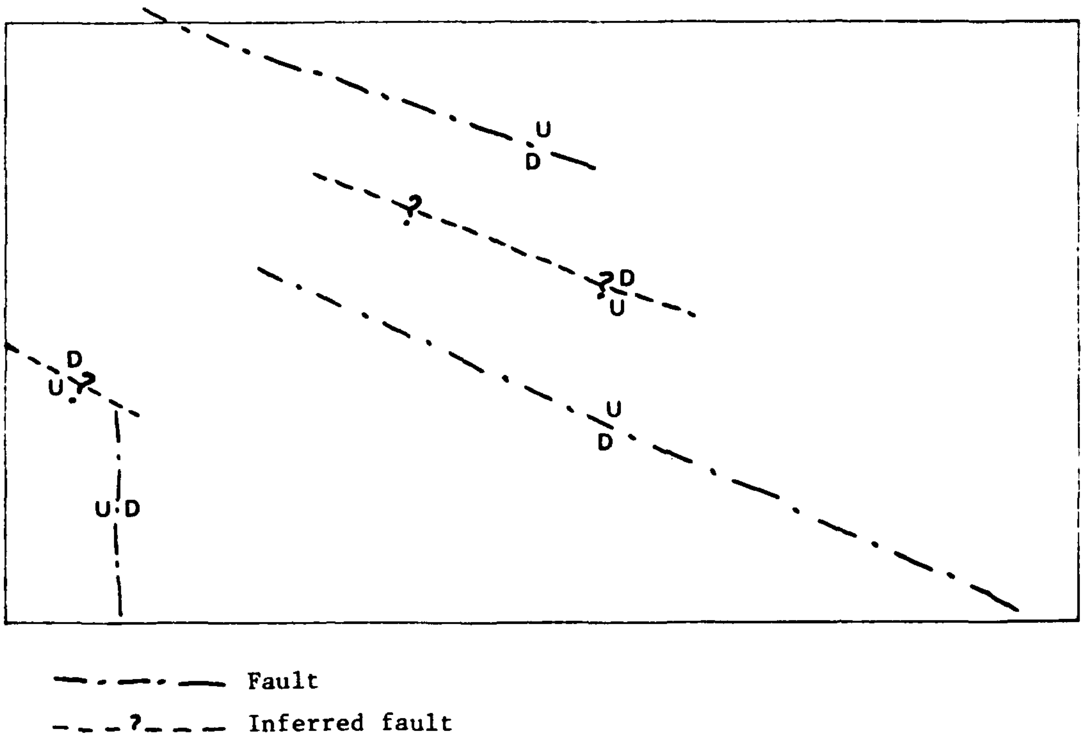


FIGURE 23. Interpretation Map, Possible Fault Locations, Bravo 19.

Gravity data indicate a large, northwest trending fault which uplifts the Blow Sand Mountains. This feature almost masks all other structures except for the deepening basement to the south. The deepening basement is also indicated by the usable data obtained by the magnetic survey. Both techniques indicate a rising basement in the southwest corner.

Thermal gradients increase from the south toward the north along the western boundary of Bravo 19.

GEOTHERMAL TARGET

There are not enough data available to provide a positive geothermal target on Range Bravo 19. Of the information gathered, only the northward increasing thermal gradients found on the western side of the range give any evidence of possible subsurface thermal fluids. It is possible that fluids from Lee Hot Springs--located 1 mile (0.62 km) north of the northwest corner of the Range--are migrating south onto the range. A thermal gradient hole or observation hole placed in section 2 would supply valuable temperature information and perhaps shed light on the possible heat source for Lee Hot Springs. Extensive exploration work is also required over the entire eastern half of Range Bravo 19.

CONCLUSIONS AND RECOMMENDATIONS

The geothermal potential of lands comprising NAWTC is considered high on NAS Fallon, and better than average on Ranges Bravo 16 and Bravo 19. Reasons are summarized in the following.

NAS FALLON

1. Thermal gradients throughout NAS Fallon are above average for the Basin and Range province. The highest gradients are in the southeast corner of the base.

2. The southeast corner is characterized by high mercury concentrations, low residual gravity, and moderately low magnetics.

3. A 2,025-foot (617-m) observation hole drilled in the southeast corner recorded a bottom hole temperature of 206°F (96.7°C) giving a gradient of 7.56°F/100 feet (13.77°C/100 m). The hole was drilled through unconsolidated sediments which included a 300-foot (91-m) zone of hydrothermal mineralization. Rhyolitic rock was encountered from 1,800 feet (549 m) to total depth.

4. A hot artesian well, 163-feet (50-m) deep with a bottom hole temperature of 170°F (77°C), is located 2 miles (3.2 km) south of the southeast corner of NAS Fallon.

The extent of the thermal fluids is believed to be in excess of 2 square miles (3.2 km^2) beneath southeast NAS Fallon. Further work,

including an observation hole that penetrates the basement, is needed to define the source.

RANGE BRAVO 16

1. Thermal gradients, drilled in the northern half of Bravo 16, all exhibit higher than normal thermal gradients. However, they are lower than those found in the southeast corner of NAS Fallon.

2. The mercury concentration over Range Bravo 16 is low.

3. No surface manifestation of subsurface thermal fluids occur in the area.

4. Gravity and magnetic studies indicate a complex basement beneath the northern half on Range Bravo 16. The studies also show a large, northwestward striking subsurface feature paralleling the Dead Camel Mountains in the southern half.

It is possible that geothermal fluids are migrating from the Lee Hot Springs area to the southeast along the buried feature and faults extending from the feature defined in paragraph 4 above. Further work would include expanded thermal gradient drilling near the center of the range, as well as deep observation holes in the northern half of the range.

RANGE BRAVO 19

1. Due to the large amounts of sand, only the western half of Range Bravo 19 was investigated using surface exploration methods. The mercury content was low, but this method was deemed inconclusive due to the soil type (sand). Land magnetics were ambiguous due to the large amount of magnetic material in the basalts of the Blow Sand Mountains. Gravity indicated a large gradient, dropping from the north to the south, believed to be due to the structual feature defining the southern Blow Sand Mountains. This large gradient tended to mask the gravity signature of other features.

2. The thermal gradient from five holes drilled along the western boundary of Range Bravo 19 increases from the south to the north. All gradients are above average for the Basin and Range.

Thermal gradients are the best indication of possible subsurface thermal fluids, showing a rise in temperature to the north as Lee Hot Springs is approached. The source and subsurface extent of the fluids associated with the Lee Hot Springs is not known, but it seems possible that they extend under the Blow Sand Mountains along the northern boundary of Range Bravo 19. Further work would include the drilling of thermal gradient holes in that area.

REFERENCES

1. Naval Weapons Center. *Evaluation of Geothermal Potential of Range Bravo 17 and the Shoal Site, Naval Air Station, Fallon*, by J. A. Whelan, C. R. Rodgers, J. Brown, and Jack Neffew. China Lake, Calif., NWC, March 1980. (NWC TP 6142, publication UNCLASSIFIED.)

2. ------. *Fallon Geothermal Exploration Project, Naval Air Station, Fallon, Nevada*, by James L. Bruce. China Lake, Calif., NWC, May 1980. (NWC TP 6194, publication UNCLASSIFIED.)

3. Naval Weather Service. "Station Climatic Summary, Fallon, Nevada." 1972.

4. George A. Thompson and Dennis B. Burke. "Regional Geophysics of the Basin and Range Province," in *Annual Review of Earth and Planetary Sciences*, Vol. 2 (1974) pp. 213-238.

5. Naval Weapons Center. *Western Division Naval Facilities Engineering Command Programmatic Preliminary Environmental Assessment (PPEA) for the Fallon Naval Air Station Geothermal Development Program, Fallon, Nevada*. China Lake, Calif., NWC, 1981. (NWC AdPub 263, publication UNCLASSIFIED.)

6. G. P. Woollard. "Regional Variations in Gravity," in *The Nature of the Solid Earth*, ed by E. Robertson. New York, McGraw, 1972. Pp. 463-505.

7. R. F. Roy, D. D. Blackwell, and E. R. Decker. "Continental Heat Flow," in *The Nature of the Solid Earth*, ed by E. Robertson. New York, McGraw, 1972. P. 504-543.

8. A. H. Lachenbruch. "Crustal Temperature and Heat Production: Implications of the Linear Heat-Flow Relation," *Journal of Geophysical Research*, Vol. 75 (1970), pp. 3291-3300.

9. G. V. Keller, L. T. Grose, and R. A. Crewsdon. "Speculations on Nature of Geothermal Energy in Basin and Province of Western United States," in *Studies of a Geothermal System in Northwestern Nevada, Part 2*, Colorado School of Mines Quarterly, Vol. 3, No. 4 (October 1978), pp. 71-76.

10. Douglas D. Hastings. "Results of Exploratory Drilling Northern Fallon Basin, Western Nevada," in *RMAG-UAG, 1979 Basin and Range Symposium Guidebook*, pp. 515-522.

11. Dennis T. Trexler, Brian A. Koenig, Thomas Flynn, James L. Bruce, and George Ghusn, Jr. "Low-to-Moderate Temperature Geothermal Resource Assessment for Nevada: Area Specific Studies," Nevada Bureau

of Mines and Geology, University of Nevada, Reno, Nevada. U.S. Department of Energy (DOE/NV/10039-3).

12. Ronald Willden and Robert C. Speed. "Geology and Mineral Deposits of Churchill County, Nevada," in *Nevada Bureau of Mines and Geology, Bulletin 83*, 1974.

13. B. M. Page. "Preliminary Geologic Map of a Part of the Stillwater Range, Churchill County, Nevada." Nevada Bureau of Mines, Map 28, 1965.

14. R. C. Speed. "Mechanics of Emplacement of a Gabbroic Lopolith, Northwestern Nevada" (abs), *Geol. Soc. America Spec.*, Paper 82 (1966), p. 208.

15. R. B. Morrison. "Lake Lahontan: Geology of Southern Carson Desert, Nevada." United States Geological Survey Professional Paper 401, 1964.

16. D. T. Trexler, E. J. Bell, and G. H. Roquemore. "Evaluation of Lineament Analysis as an Exploration Technique for Geothermal Energy, Western and Central Nevada." Final report of work performed for the U.S. Department of Energy under Contract No. E4-76-5-08-0671, 1978.

17. Richard L. Nielson. "Right-Lateral Strike-Slip Faulting in the Walker Lane, West-Central Nevada," *Geological Society of America Bulletin*, Vol. 76 (1965), pp. 1301-1308.

18. R. W. Greensfelder. "The Pg-Pn Method of Determining Depth of Focus With Applications to Nevada Earthquakes," *Seismol. Soc. America Bull.*, Vol. 55, pp. 391-403.

19. M. H. McCarthy, W. W. Vaughn, R. E. Learned, and J. L. Menschke. "Mercury in Soil Gas and Air - A Potential Tool in Mineral Exploration." United States Geological Survey Circular 609, 1969.

20. L. L. Nettleton. *Gravity and Magnetics in Oil Prospecting*. McGraw-Hill Company, 1976.

21. Sigmund Hammer. "Terrain Corrections for Gravimeter Stations," *Geophysics*, Vol. 4, pp. 184-194.

22. Milton B. Dobrin. *Introduction to Geophysical Prospecting*. McGraw-Hill Company, 1976.

23. United States Geological Survey. "Aeromagnetic Map of Nevada - Reno Sheet." Nevada Bureau of Mines and Geology, Map 54, 1977.

24. D. I. Axelrod. "Mio-Pliocene Floras From West-Central Nevada." *California Univ. Pub. Geol. Sci.*, Vol. 33, pp. 1-321.

Appendix A

GRAVITY AND MAGNETIC FACTS NAS FALLON

Latitude = degrees minutes.hundreths of a minute

Longitude = degrees minutes.hundreths of a minute

Elevation = feet above mean sea level

T.C. = terrain correction in milligals (hand picked through Hammer Zone M, using a density of 2.0 gm/cc)

Observed Gravity = milligals

Complete Bouguer = milligals, values reduced by using the Geodetic Reference System, 1967

Magnetics = ground magnetic value in gammas

Gravity and Magnetic Facts, Mainbase Fallon.

Station ID	Latitude	Longitude	Elevation (ft)	T.C.	Observed Gravity	Complete Bouguer		Corrected Magnetics (gammas)
						2.67 gm/cc	2.00 gm/cc	
MF1	39 24.15	118 43.40	3928.19	0.01	979711.43	-168.9	-135.3	52581
MF2	39 24.13	118 43.17	3927.72	0.02	979711.72	-168.6	-135.0	52633
MF3	39 24.13	118 42.93	3926.99	0.01	979712.10	-168.3	-134.7	52652
MF4	39 24.15	118 42.72	3925.53	0.02	979712.51	-168.0	-134.4	52600
MF5	39 24.15	118 42.52	3925.02	0.02	979712.85	-167.6	-134.1	52695
MF6	39 24.13	118 42.37	3924.82	0.02	979713.11	-167.4	-133.8	52724
MF7	39 24.15	118 42.27	3928.34	0.02	979713.02	-167.3	-133.7	52635
MF8	39 24.33	118 42.25	3924.98	0.00	979713.65	-167.1	-133.6	52604
MF9	39 24.48	118 42.28	3927.48	0.00	979713.72	-167.1	-133.5	52695
MF10	39 24.55	118 42.48	3926.69	0.00	979713.62	-167.4	-133.8	52714
MF11	39 24.55	118 42.72	3925.86	0.00	979713.25	-167.8	-134.2	52681
MF12	39 24.55	118 42.83	3925.89	0.00	979713.16	-167.9	-134.3	52676
MF13	39 24.68	118 42.85	3927.16	0.01	979713.37	-167.8	-134.2	52693
MF14	39 24.77	118 43.02	3927.82	0.00	979713.31	-168.0	-134.3	52679
MF15	39 24.92	118 42.98	3927.64	0.01	979713.77	-167.7	-134.1	52688
MF16	39 25.07	118 42.90	3930.21	0.00	979714.08	-167.5	-133.9	52699
MF17	39 25.22	118 42.83	3929.04	0.01	979714.65	-167.2	-133.6	52715
MF18	39 25.37	118 42.83	3932.43	0.00	979714.80	-167.1	-133.4	52677
MF19	39 25.50	118 42.97	3933.06	0.00	979715.03	-167.0	-133.4	52562
MF20	39 25.63	118 43.10	3934.54	0.00	979715.17	-167.0	-133.3	52676
MF21	39 25.77	118 43.22	3936.10	0.00	979715.37	-166.9	-133.2	52679
MF22	39 25.90	118 43.35	3937.82	0.00	979715.53	-166.8	-133.1	52648
MF23	39 26.07	118 43.42	3940.03	0.01	979715.89	-166.6	-132.9	52722
MF24	39 26.25	118 43.43	3942.16	0.01	979716.36	-166.2	-132.5	52549
MF25	39 26.42	118 43.43	3943.05	0.02	979716.81	-166.0	-132.2	52607
MF26	39 26.58	118 43.43	3943.32	0.01	979717.33	-165.7	-131.9	52569
MF27	39 26.75	118 43.43	3945.23	0.02	979717.78	-165.3	-131.6	52629
MF28	39 26.88	118 43.42	3944.26	0.03	979718.31	-165.1	-131.3	52615
MF29	39 25.30	118 43.00	3931.25	0.00	979714.58	-167.3	-133.6	52665
MF30	39 25.27	118 43.23	3934.04	0.00	979714.19	-167.4	-133.8	52407
MF31	39 25.23	118 43.40	3933.04	0.01	979713.93	-167.7	-134.1	52624

Gravity and Magnetic Facts, Mainbase Fallon.

Station ID	Latitude	Longitude	Elevation (ft)	T.C.	Observed Gravity	Complete Bouguer		Corrected Magnetics (gammas)
						2.67 gm/cc	2.00 gm/cc	
MF32	39 25.03	118 43.42	3933.80	0.03	979713.28	-168.0	-134.3	52506
MF33	39 24.85	118 43.42	3932.64	0.01	979712.84	-168.2	-134.6	52603
MF34	39 24.70	118 43.42	3931.46	0.02	979712.58	-168.3	-134.7	52641
MF35	39 24.53	118 43.42	3932.08	0.07	979712.17	-168.4	-134.8	52461
MF36	39 24.35	118 43.42	3930.99	0.07	979711.75	-168.6	-135.0	52556
MF37	39 24.18	118 43.42	3929.07	0.11	979711.52	-168.7	-135.1	52626
MF38	39 24.65	118 42.13	3928.76	0.00	979714.28	-166.8	-133.1	52810
MF39	39 24.80	118 42.13	3925.48	0.00	979714.84	-166.6	-133.0	52776
MF40	39 24.92	118 42.13	3925.98	0.00	979715.13	-166.5	-132.9	52777
MF41	39 25.08	118 42.18	3927.40	0.00	979715.30	-166.5	-132.9	52776
MF42	39 25.22	118 42.27	3929.70	0.00	979715.35	-166.5	-132.8	52779
MF43	39 25.37	118 42.22	3930.11	0.00	979715.76	-166.3	-132.6	52915
MF44	39 25.52	118 42.25	3930.47	0.00	979716.05	-166.2	-132.5	52778
MF45	39 25.60	118 42.20	3931.32	0.00	979716.26	-166.0	-132.4	52793
MF46	39 25.72	118 42.12	3930.08	0.00	979716.17	-165.8	-132.2	52738
MF47	39 25.82	118 42.22	3932.46	0.00	979716.70	-165.8	-132.2	52726
MF48	39 25.87	118 42.37	3936.20	0.00	979716.41	-166.0	-132.3	52717
MF49	39 26.05	118 42.37	3930.73	0.00	979717.50	-165.5	-131.9	52699
MF50	39 26.18	118 42.45	3932.45	0.00	979717.54	-165.5	-131.9	52665
MF51	39 26.28	118 42.53	3933.15	0.00	979717.75	-165.4	-131.8	52647
MF52	39 26.47	118 42.53	3937.28	0.00	979717.97	-165.2	-131.6	52624
MF53	39 26.65	118 42.55	3935.00	0.00	979718.73	-164.9	-131.2	52627
MF54	39 26.73	118 42.57	3937.16	0.01	979718.80	-164.8	-131.1	52614
MF55	39 26.75	118 42.78	3938.00	0.01	979718.62	-165.0	-131.3	52618
MF56	39 26.75	118 42.98	3941.29	0.01	979718.22	-165.2	-131.4	52620
MF57	39 26.75	118 43.18	3943.66	0.03	979717.91	-165.3	-131.6	52615
MF58	39 26.82	118 42.33	3943.35	0.03	979718.15	-165.2	-131.5	52599
MF59	39 26.73	118 42.35	3944.25	0.01	979718.85	-164.3	-130.6	52386
MF60	39 26.73	118 42.12	3937.05	0.03	979719.21	-164.4	-130.7	52648
MF61	39 26.70	118 41.88	3933.68	0.02	979719.60	-164.2	-130.5	52646

Gravity and Magnetic Facts, Mainbase Fallon.

Station ID	Latitude	Longitude	Elevation (ft)	T.C.	Observed Gravity	Complete Bouguer 2.67 gm/cc	Complete Bouguer 2.00 gm/cc	Corrected Magnetics (gammas)
MF62	39 26.65	118 41.68	3932.76	0.01	979719.80	-163.9	-130.3	52624
MF63	39 26.62	118 41.47	3934.59	0.02	979719.82	-163.8	-130.1	52655
MF64	39 26.57	118 41.25	3933.51	0.01	979720.08	-163.5	-129.9	52624
MF65	39 26.45	118 41.20	3931.28	0.01	979719.90	-163.6	-130.0	52659
MF66	39 26.27	118 41.20	3932.31	0.02	979719.26	-163.9	-130.3	52685
MF67	39 26.10	118 41.20	3930.78	0.02	979718.95	-164.1	-130.5	52721
MF68	39 25.93	118 41.20	3929.62	0.01	979718.55	-164.3	-130.7	52721
MF69	39 25.77	118 41.18	3931.41	0.01	979718.03	-164.5	-130.9	52734
MF70	39 25.60	118 41.18	3931.68	0.01	979717.68	-164.6	-130.9	52766
MF71	39 25.43	118 41.18	3926.98	0.00	979717.67	-164.6	-131.0	52761
MF72	39 25.25	118 41.18	3925.53	0.00	979717.37	-164.7	-131.2	52760
MF73	39 25.08	118 41.18	3928.05	0.01	979716.80	-164.9	-131.3	52768
MF74	39 24.92	118 41.18	3928.12	0.03	979716.46	-165.0	-131.4	52782
MF75	39 24.73	118 41.17	3928.85	0.03	979716.08	-165.0	-131.4	52772
MF76	39 24.62	118 41.15	3924.87	0.00	979716.05	-165.2	-131.6	52776
MF77	39 24.48	118 41.02	3922.54	0.01	979716.19	-165.0	-131.4	52745
MF78	39 24.33	118 40.90	3922.55	0.01	979716.25	-164.7	-131.1	52737
MF79	39 24.15	118 40.87	3921.25	0.01	979716.20	-164.5	-131.0	52769
MF80	39 24.03	118 41.03	3922.90	0.02	979715.64	-164.8	-131.3	52714
MF81	39 24.00	118 41.22	3921.80	0.03	979715.25	-165.2	-131.7	52712
MF82	39 24.15	118 41.35	3925.22	0.04	979715.02	-164.4	-131.9	52740
MF83	39 24.15	118 41.58	3927.02	0.02	979714.43	-166.0	-132.4	52685
MF84	39 24.15	118 41.83	3926.86	0.02	979713.99	-166.4	-132.8	52699
MF85	39 24.15	118 42.07	3928.30	0.07	979713.42	-166.8	-133.2	52699
MF86	39 24.15	118 40.62	3923.08	0.02	979716.82	-163.8	-130.2	52667
MF87	39 23.97	118 40.62	3920.28	0.01	979716.85	-163.7	-130.1	52643
MF88	39 23.80	118 40.62	3920.28	0.03	979716.79	-163.5	-129.9	52663
MF89	39 23.65	118 40.62	3920.32	0.05	979716.75	-163.3	-129.7	52668
MF90	39 23.52	118 40.62	3917.77	0.01	979716.96	-163.0	-129.5	52669
MF91	39 23.30	118 40.63	3918.52	0.02	979717.11	-162.5	-129.0	52673
MF92	39 23.30	118 40.38	3916.77	0.01	979718.20	-161.6	-128.0	52675

Gravity and Magnetic Facts, Mainbase Fallon.

Station ID	Latitude	Longitude	Elevation (ft)	T.C.	Observed Gravity	Complete Bouguer 2.67 gm/cc	Complete Bouguer 2.00 gm/cc	Corrected Magnetics (gammas)
MF93	39 23.15	118 40.35	3915.58	0.01	979718.46	-161.1	-127.6	52693
MF94	39 23.08	118 40.07	3917.84	0.01	979719.64	-159.7	-126.2	52702
MF95	39 23.08	118 39.87	3916.70	0.01	979720.91	-158.5	-125.0	52722
MF96	39 23.08	118 39.65	3918.74	0.01	979722.14	-157.2	-123.6	52806
MF97	39 22.85	118 39.65	3915.95	0.01	979722.44	-156.7	-123.9	52836
MF98	39 22.85	118 39.87	3916.50	0.01	979720.76	-158.3	-124.8	52745
MF99	39 22.85	118 40.08	3916.80	0.01	979719.53	-159.5	-126.0	52704
MF100	39 22.85	118 40.30	3917.24	0.01	979718.48	-160.6	-127.1	52735
MF101	39 22.85	118 40.52	3916.90	0.01	979717.64	-161.4	-127.9	52593
MF102	39 22.85	118 40.73	3917.00	0.01	979716.90	-162.2	-128.7	52750
MF103	39 22.85	118 40.95	3917.27	0.01	979716.18	-162.9	-129.4	52866
MF104	39 22.85	118 41.18	3920.00	0.01	979715.16	-163.7	-130.2	52737
MF105	39 22.85	118 41.38	3919.28	0.02	979714.55	-164.4	-130.8	52722
MF106	39 22.85	118 41.60	3919.11	0.01	979713.90	-165.0	-131.5	52722
MF107	39 22.83	118 41.82	3919.61	0.01	979713.14	-165.8	-132.2	52700
MF108	39 22.85	118 42.03	3919.35	0.01	979712.55	-166.4	-132.9	52680
MF109	39 22.85	118 42.18	3919.13	0.01	979712.25	-166.7	-133.2	52689
MF110	39 22.85	118 42.30	3919.32	0.03	979711.88	-167.0	-133.5	52675
MF111	39 23.00	118 42.30	3921.44	0.01	979711.93	-167.1	-133.5	52887
MF112	39 23.17	118 42.30	3922.06	0.01	979712.02	-167.2	-133.7	52119
MF113	39 23.35	118 42.28	3922.39	0.01	979712.25	-167.2	-133.7	52731
MF114	39 23.53	118 42.28	3921.93	0.01	979712.55	-167.2	-133.7	52738
MF115	39 23.70	118 42.28	3922.81	0.01	979712.77	-167.2	-133.7	52740
MF116	39 23.88	118 42.28	3923.20	0.01	979712.94	-167.3	-133.7	52817
MF117	39 24.05	118 42.28	3925.06	0.00	979713.17	-167.2	-133.6	52652
MF118	39 23.28	118 42.05	3925.72	0.03	979712.44	-166.7	-133.1	52690
MF119	39 23.28	118 41.83	3922.72	0.02	979713.23	-166.1	-132.6	52694
MF120	39 23.28	118 41.62	3922.42	0.01	979713.82	-165.6	-132.0	52700
MF121	39 23.28	118 41.38	3921.05	0.03	979714.60	-164.8	-131.3	52689
MF122	39 23.28	118 41.18	3920.37	0.01	979715.19	-164.3	-130.8	52657
MF123	39 23.28	118 40.92	3919.58	0.03	979716.00	-163.5	-130.0	52693

Gravity and Magnetic Facts, Mainbase Fallon.

Station ID	Latitude	Longitude	Elevation (ft)	T.C.	Observed Gravity	Complete Bouguer 2.67 gm/cc	Complete Bouguer 2.00 gm/cc	Corrected Magnetics (gammas)
MF124	39 23.28	118 41.70	3920.07	0.03	979716.66	-162.8	-129.3	52688
MF125	39 25.62	118 41.38	3927.12	0.00	979717.67	-164.9	-131.3	52770
MF126	39 25.65	118 41.58	3927.33	0.00	979717.49	-165.1	-131.5	52781
MF127	39 25.72	118 41.78	3930.94	0.00	979717.01	-165.5	-131.8	52774
MF128	39 25.77	118 41.98	3929.40	0.00	979716.98	-165.7	-132.0	52764
MF129	39 22.98	118 39.43	3921.49	0.01	979724.53	-154.5	-120.9	52995
MF130	39 23.13	118 39.55	3921.47	0.01	979722.63	-156.6	-123.0	52844
MF131	39 23.25	118 39.65	3922.09	0.01	979721.50	-157.9	-124.3	52781
MF132	39 23.42	118 39.58	3921.88	0.03	979721.74	-157.9	-124.3	52798
MF133	39 23.60	118 39.52	3922.67	0.03	979721.68	-158.1	-124.6	52816
MF134	39 23.77	118 39.55	3923.09	0.04	979721.17	-158.9	-125.3	52768
MF135	39 23.92	118 39.60	3922.93	0.03	979720.80	-159.5	-125.9	52740
MF136	39 24.07	118 39.62	3925.39	0.02	979720.54	-159.8	-126.2	52729
MF137	39 24.30	118 39.72	3923.45	0.02	979720.22	-160.6	-127.0	52736
MF138	39 24.42	118 39.85	3925.27	0.02	979719.44	-161.4	-127.9	52742
MF139	39 24.53	118 40.03	3921.35	0.03	979718.99	-162.3	-128.7	52756
MF140	39 24.68	118 40.05	3924.56	0.02	979718.84	-162.5	-128.9	52769
MF141	39 24.88	118 40.05	3924.36	0.01	979719.26	-162.4	-128.8	52743
MF142	39 25.07	118 40.05	3924.18	0.01	979719.63	-162.3	-128.7	52680
MF143	39 25.25	118 40.05	3926.60	0.01	979719.76	-162.3	-128.7	52617
MF144	39 25.42	118 40.05	3925.84	0.01	979720.12	-162.2	-128.6	52604
MF145	39 25.63	118 40.05	3926.43	0.01	979720.43	-162.2	-128.6	52565
MF146	39 25.80	118 40.05	3927.72	0.01	979720.58	-162.2	-128.6	52577
MF147	39 25.97	118 40.05	3926.73	0.01	979721.04	-162.1	-128.5	52594
MF148	39 26.13	118 40.05	3927.98	0.01	979721.27	-162.0	-128.4	52598
MF149	39 26.28	118 40.05	3928.02	0.01	979721.62	-161.9	-128.3	52600
MF150	39 26.33	118 40.27	3928.44	0.01	979721.34	-162.2	-128.6	52619
MF151	39 26.38	118 40.48	3928.51	0.01	979720.91	-162.7	-129.1	52632
MF152	39 26.43	118 40.70	3930.76	0.01	979720.60	-162.9	-129.3	52657
MF153	39 26.50	118 40.92	3929.13	0.01	979720.62	-163.1	-129.5	52671
MF154	39 26.55	118 41.12	3931.65	0.01	979720.29	-163.4	-129.7	52608

Gravity and Magnetic Facts, Mainbase Fallon.

Station ID	Latitude	Longitude	Elevation (ft)	T.C.	Observed Gravity	Complete Bouguer		Corrected Magnetics (gammas)
						2.67 gm/cc	2.00 gm/cc	
MF155	39 24.15	118 40.42	3922.71	0.02	979717.62	-163.0	-129.5	52708
MF156	39 24.15	118 40.20	3921.44	0.01	979718.57	-162.2	-128.6	52686
MF157	39 24.15	118 39.98	3921.73	0.01	979719.47	-161.2	-127.7	52759
MF158	39 24.17	118 39.82	3923.44	0.01	979720.09	-160.5	-127.0	52683
MF159	39 26.73	118 41.20	3930.96	0.01	979720.85	-163.1	-129.5	52649
MF160	39 26.92	118 41.20	3931.66	0.01	979721.49	-162.7	-129.1	52637
MF161	39 27.08	118 41.20	3931.76	0.01	979722.21	-162.2	-128.6	52610
MF162	39 27.25	118 41.20	3932.83	0.01	979722.92	-161.7	-128.1	52582
MF163	39 27.42	118 41.20	3932.63	0.01	979723.53	-161.4	-127.7	52570
MF164	39 27.57	118 41.20	3934.92	0.00	979724.01	-161.0	-127.3	52553
MF165	39 27.62	118 41.37	3934.66	0.00	979723.76	-161.3	-127.6	52556
MF166	39 27.62	118 41.58	3935.24	0.00	979723.23	-161.8	-128.1	52568
MF167	39 27.63	118 41.80	3937.20	0.01	979722.68	-162.3	-128.6	52536
MF168	39 27.63	118 42.03	3937.76	0.01	979722.30	-162.6	-128.9	52574
MF169	39 27.63	118 42.35	3939.17	0.03	979721.79	-163.0	-129.3	52562
MF170	39 27.78	118 42.37	3941.50	0.05	979722.15	-162.7	-129.0	52563
MF171	39 27.95	118 42.33	3942.84	0.01	979722.76	-162.3	-128.6	52574
MF172	39 28.08	118 42.33	3944.96	0.01	979723.16	-162.0	-128.2	52578
MF173	39 28.08	118 42.60	3945.61	0.01	979722.97	-162.1	-128.4	52599
MF174	39 28.08	118 42.80	3943.39	0.00	979722.91	-162.3	-128.6	52535
MF175	39 28.07	118 43.03	3943.18	0.01	979722.79	-162.4	-128.7	52590
MF176	39 28.07	118 43.27	3944.59	0.01	979722.80	-162.3	-128.6	52601
MF177	39 28.03	118 43.48	3944.42	0.01	979723.08	-162.0	-128.3	52546
MF178	39 28.02	118 43.67	3946.46	0.00	979723.06	-161.9	-128.1	52550
MF179	39 27.98	118 43.90	3948.54	0.01	979723.13	-161.6	-127.9	52550
MF180	39 27.97	118 44.02	3950.22	0.02	979722.98	-161.7	-127.9	52539
MF181	39 27.77	118 44.02	3946.88	0.02	979722.02	-162.5	-128.8	52643
MF182	39 27.60	118 44.02	3946.06	0.00	979721.11	-163.2	-129.5	52624
MF183	39 27.40	118 44.00	3947.77	0.01	979720.07	-163.9	-130.1	52614
MF184	39 27.25	118 44.08	3948.52	0.01	979719.27	-164.4	-130.6	52628
MF185	39 27.15	118 43.85	3949.61	0.03	979718.78	-164.7	-130.9	52584

Gravity and Magnetic Facts, Mainbase Fallon.

Station ID	Latitude	Longitude	Elevation (ft)	T.C.	Observed Gravity	Complete Bouguer		Corrected Magnetics (gammas)
						2.67 gm/cc	2.00 gm/cc	
MF186	39 27.03	118 43.68	3944.81	0.00	9/9718.71	-164.9	-131.1	52613
MF187	39 26.95	118 43.57	3944.60	0.03	979718.48	-165.0	-131.2	52602
MF188	39 27.38	118 44.30	3950.07	0.02	979719.80	-164.0	-130.2	52625
MF189	39 27.52	118 44.58	3950.81	0.01	979720.49	-163.5	-129.7	52645
MF190	39 27.28	118 44.58	3952.83	0.03	979719.22	-164.2	-130.4	52618
MF191	39 27.10	118 44.58	3950.87	0.02	979718.54	-164.8	-131.0	52608
MF192	39 26.90	118 44.58	3949.62	0.03	979717.88	-165.2	-131.4	52613
MF193	39 26.68	118 44.58	3949.02	0.03	979717.18	-165.6	-131.8	52557
MF194	39 26.48	118 44.58	3948.98	0.03	979716.50	-166.0	-132.2	52617
MF195	39 26.27	118 44.57	3948.85	0.01	979715.76	-166.5	-132.7	52633
MF196	39 26.07	118 44.57	3947.97	0.03	979715.10	-166.8	-133.1	52640
MF197	39 25.85	118 44.57	3945.92	0.02	979714.47	-167.3	-133.5	52619
MF198	39 25.63	118 44.55	3945.17	0.02	979713.68	-167.8	-134.1	52651
MF199	39 25.45	118 44.55	3943.04	0.03	979713.20	-168.1	-134.4	52665
MF200	39 25.25	118 44.55	3943.06	0.05	979712.57	-168.4	-134.7	52516
MF201	39 25.02	118 44.55	3943.60	0.03	979711.85	-168.8	-135.1	52616
MF202	39 24.80	118 44.55	3941.57	0.07	979711.34	-169.1	-135.4	52598
MF203	39 24.58	118 44.55	3938.04	0.03	979710.99	-169.4	-135.7	52607
MF204	39 24.38	118 44.55	3933.96	0.03	979710.68	-169.6	-136.0	52590
MF205	39 24.10	118 44.53	3934.90	0.02	979709.71	-170.1	-136.5	52557
MF206	39 24.12	118 44.27	3932.36	0.02	979710.18	-169.8	-136.2	52601
MF207	39 24.12	118 44.00	3932.09	0.01	979710.40	-169.6	-136.0	52583
MF208	39 24.13	118 43.70	3930.79	0.02	979710.84	-169.3	-135.7	52600
MF209	39 23.92	118 43.98	3928.83	0.01	979710.12	-169.8	-136.2	52554
MF210	39 23.68	118 43.98	3929.70	0.01	979709.45	-170.1	-136.5	52564
MF211	39 23.65	118 43.70	3926.96	0.00	979709.90	-169.8	-136.2	52568
MF212	39 23.68	118 43.40	3926.52	0.01	979710.30	-169.4	-135.8	52573
MF213	39 23.45	118 43.42	3922.87	0.01	979709.95	-169.7	-136.1	52587
MF214	39 23.25	118 43.43	3925.21	0.01	979709.33	-169.8	-136.3	52586
MF215	39 23.27	118 43.17	3923.97	0.02	979709.85	-169.4	-135.8	52625
MF216	39 23.27	118 42.90	3925.61	0.02	979710.23	-168.9	-135.3	52650
MF217	39 23.27	118 42.63	3924.61	0.02	979711.03	-168.2	-134.6	52705

Appendix B

GRAVITY AND MAGNETIC FACTS
RANGE BRAVO 16

Latitude = degrees minutes.hundreths of a minute

Longitude = degrees minutes.hundreths of a minute

Elevation = feet above mean sea level

T.C. = terrain correction in milligals (hand picked through Hammer Zone M, using a density of 2.0 gm/cc)

Observed Gravity = milligals

Complete Bouguer = milligals, values reduced by using the Geodetic Reference System, 1967

Magnetics = ground magnetic value in gammas

Gravity and Magnetic Facts, Range Bravo 16.

Station ID	Latitude	Longitude	Elevation (ft)	T.C.	Observed Gravity	Complete Bouguer 2.67 gm/cc	Complete Bouguer 2.4 gm/cc	Corrected Magnetics (gammas)
BS1	39 20.98	118 57.27	4331.115	0.28	979702.84	-148.3	-133.4	52588
BS2	39 21.08	118 57.12	4291.77	0.35	979704.97	-148.6	-133.8	52539
BS3	39 21.18	118 56.97	4260.48	0.33	979706.57	-149.0	-134.4	52597
BS4	39 21.25	118 56.73	4219.75	0.29	979710.06	-148.1	-133.6	52741
BS5	39 21.40	118 56.63	4199.43	0.31	979711.66	-147.9	-133.5	52764
BS6	39 21.53	118 56.55	4178.70	0.27	979712.63	-148.5	-134.1	52625
BS7	39 21.63	118 56.38	4163.06	0.32	979713.68	-148.4	-134.1	52608
BS8	39 21.72	118 56.20	4147.55	0.30	979714.65	-148.5	-134.3	52604
BS9	39 21.77	118 55.98	4120.55	0.27	979716.29	-148.6	-134.5	52553
BS10	39 21.83	118 55.80	4097.93	0.29	979717.42	-148.9	-134.8	52363
BS11	39 21.88	118 55.58	4085.97	0.27	979717.21	-150.0	-135.9	52511
BS12	39 21.87	118 55.42	4089.43	0.24	979716.47	-150.5	-136.4	52466
BS13	39 21.85	118 55.18	4047.50	0.22	979719.92	-149.6	-135.6	52625
BS14	39 21.92	118 54.98	4016.01	0.17	979721.11	-150.4	-136.6	52612
BS15	39 21.95	118 54.78	4002.75	0.18	979720.86	-151.5	-137.7	52406
BS16	39 22.00	118 54.57	3989.98	0.16	979721.91	-151.3	-137.6	52747
BS17	39 22.05	118 54.37	3973.61	0.13	979722.80	-151.5	-137.9	52571
BS18	39 22.12	118 54.18	3964.33	0.13	979724.00	-151.0	-137.3	52478
BS19	39 22.20	118 54.00	3962.69	0.12	979724.00	-151.2	-137.6	52714
BS20	39 22.28	118 53.82	3953.15	0.12	979724.18	-151.7	-138.1	52534
BS21	39 22.35	118 53.63	3952.33	0.12	979724.29	-151.8	-138.2	52553
BS22	39 22.37	118 53.52	3952.51	0.11	979724.21	-151.9	-138.3	52516
BS23	39 22.37	118 53.32	3952.59	0.11	979723.57	-152.5	-138.9	52592
BS24	39 22.37	118 53.10	3952.71	0.11	979723.07	-153.0	-139.4	52637
BS25	39 22.37	118 52.88	3950.45	0.11	979722.85	-153.4	-139.8	52492
BS26	39 22.37	118 52.68	3950.74	0.11	979721.83	-154.4	-140.8	52377
BS27	39 22.37	118 52.47	3953.54	0.11	979720.65	-155.4	-141.8	
BS28	39 22.38	118 52.25	3947.57	0.11	979719.63	-156.8	-143.2	52506
BS29	39 22.38	118 52.05	3947.45	0.11	979717.86	-158.6	-145.0	52545
BS30	39 22.38	118 51.83	3951.83	0.11	979715.53	-160.6	-147.0	52553
BS31	39 22.38	118 51.63	3951.43	0.11	979714.07	-162.1	-148.5	52607
BS32	39 22.38	118 51.42	3949.06	0.11	979712.92	-163.4	-149.8	52686

Gravity and Magnetic Facts, Range Bravo 16.

Station ID	Latitude	Longitude	Elevation (ft)	T.C.	Observed Gravity	Complete Bouguer		Corrected Magnetics (gammas)
						2.67 gm/cc	2.4 gm/cc	
BS33	39 22.38	118 51.32	3951.66	0.11	979712.19	-164.0	-150.4	52704
BS34	39 22.20	118 53.52	3952.32	0.11	979723.48	-152.4	-138.8	52486
BS35	39 22.03	118 53.52	3949.28	0.11	979722.91	-152.9	-139.3	52641
BS36	39 21.87	118 53.50	3948.23	0.11	979722.28	-153.3	-139.7	52676
BS37	39 21.68	118 53.50	3947.00	0.13	979721.43	-154.0	-140.4	52668
BS38	39 21.55	118 53.50	3946.11	0.12	979721.00	-154.3	-140.7	52687
BS39	39 21.37	118 53.50	3945.68	0.12	979720.59	-154.4	-140.9	52559
BS40	39 21.22	118 53.50	3945.56	0.13	979722.15	-152.6	-139.1	52848
BS41	39 21.05	118 53.48	3945.22	0.13	979721.47	-153.1	-139.5	52592
BS42	39 20.88	118 53.48	3945.93	0.13	979723.17	-151.1	-137.5	53038
BS43	39 20.72	118 53.48	3947.90	0.13	979723.43	-150.5	-136.9	52973
BS44	39 20.55	118 53.48	3953.24	0.16	979722.22	-151.1	-137.5	52516
BS45	39 20.38	118 53.48	3950.58	0.15	979724.18	-149.0	-135.4	52615
BS46	39 20.20	118 53.47	3951.08	0.15	979724.87	-148.1	-134.5	52905
BS47	39 20.03	118 53.47	3947.89	0.15	979725.77	-147.1	-133.5	52884
BS48	39 19.87	118 53.47	3950.47	0.14	979726.09	-146.4	-132.8	52662
BS49	39 19.70	118 53.47	3949.81	0.14	979726.36	-145.9	-132.3	52531
BS50	39 19.52	118 53.47	3948.38	0.14	979726.91	-145.2	-131.6	52363
BS51	39 19.35	118 53.47	3951.08	0.16	979728.05	-143.6	-130.0	52377
BS52	39 19.17	118 53.47	3951.25	0.15	979728.30	-143.1	-129.5	52612
BS53	39 19.00	118 53.47	3952.32	0.17	979728.30	-142.7	-129.1	52773
BS54	39 18.83	118 53.47	3954.51	0.15	979728.07	-142.6	-129.0	53298
BS55	39 18.67	118 53.47	3962.14	0.16	979727.19	-142.8	-129.2	53472
BS56	39 18.50	118 53.45	3964.45	0.13	979726.47	-143.2	-129.5	53219
BS57	39 18.33	118 53.45	3967.69	0.16	979725.90	-143.3	-129.6	53039
BS58	39 18.15	118 53.47	3981.11	0.18	979724.51	-143.5	-129.8	52839
BS59	39 18.00	118 53.47	3987.37	0.20	979722.23	-145.20	-131.5	52805
BS60	39 17.80	118 53.45	4006.85	0.21	979718.86	-147.1	-133.3	52808
BS61	39 17.72	118 53.27	3996.60	0.24	979719.68	-146.7	-133.0	52843
BS62	39 17.63	118 53.08	3981.34	0.20	979720.95	-146.3	-132.6	52787
BS63	39 17.55	118 52.92	3978.23	0.25	979722.18	-145.1	-131.4	52750
BS64	39 17.48	118 52.73	3969.13	0.21	979723.23	-144.5	-130.9	52749

Gravity and Magnetic Facts, Range Bravo 16.

Station ID	Latitude	Longitude	Elevation (ft)	T.C.	Observed Gravity	Complete Bouguer 2.67 gm/cc	Complete Bouguer 2.4 gm/cc	Corrected Magnetics (gammas)
BS65	39 17.48	118 52.43	3971.40	0.22	979721.48	-146.1	-132.5	52868
BS66	39 17.50	118 52.23	3964.59	0.23	979721.46	-146.6	-132.9	52863
BS67	39 17.45	118 51.98	3953.38	0.16	979722.08	-146.6	-133.0	52958
BS68	39 17.38	118 51.73	3952.72	0.16	979720.81	-147.8	-134.2	53104
BS69	39 17.33	118 51.47	3944.14	0.15	979719.31	-149.8	-136.2	53097
BS70	39 17.37	118 51.25	3943.67	0.15	979718.13	-151.1	-137.5	53067
BS71	39 17.43	118 50.97	3940.47	0.15	979716.86	-152.6	-139.0	52873
BS72	39 19.82	118 53.40	3946.58	0.14	979726.04	-146.6	-133.0	52537
BS73	39 19.83	118 53.18	3944.22	0.17	979724.55	-148.2	-134.6	52440
BS74	39 19.87	118 52.97	3941.82	0.15	979724.10	-148.9	-135.3	52823
BS75	39 19.90	118 52.75	3940.52	0.14	979722.08	-151.0	-137.5	52321
BS76	39 19.95	118 52.52	3939.28	0.15	979720.75	-152.5	-139.0	52595
BS77	39 19.98	118 52.30	3938.85	0.15	979719.19	-154.2	-140.6	52750
BS78	39 20.05	118 52.10	3941.44	0.15	979717.58	-155.7	-142.1	52946
BS79	39 20.08	118 51.87	3937.30	0.14	979716.31	-157.3	-143.7	52783
BS80	39 20.10	118 51.63	3935.67	0.14	979714.16	-159.5	-146.0	52588
BS81	39 20.12	118 51.43	3935.03	0.15	979712.15	-161.6	-148.1	52561
BS82	39 20.12	118 51.17	3934.50	0.15	979709.86	-163.9	-150.4	52498
BS83	39 20.13	118 50.93	3934.72	0.15	979708.28	-165.5	-152.0	52526
BS84	39 20.15	118 50.72	3938.67	0.15	979706.75	-166.8	-153.3	52494
BS85	39 20.15	118 50.47	3936.39	0.15	979705.72	-168.0	-154.5	52496
BS86	39 20.15	118 50.27	3935.14	0.15	979704.87	-168.9	-155.4	52506
BS87	39 20.22	118 50.15	3933.63	0.15	979704.39	-169.6	-156.1	52484
BS88	39 20.40	118 50.15	3936.21	0.14	979704.19	-169.9	-156.4	52516
BS89	39 20.57	118 50.15	3935.71	0.11	979704.28	-170.2	-156.6	52544
BS90	39 20.63	118 50.27	3942.85	0.13	979704.22	-169.9	-156.3	52551
BS91	39 20.63	118 50.50	3937.20	0.11	979705.42	-169.0	-155.5	52503
BS92	39 20.60	118 50.73	3937.36	0.11	979706.50	-167.9	-154.3	52510
BS93	39 20.60	118 51.00	3938.33	0.12	979707.95	-166.4	-152.8	52507
BS94	39 20.60	118 51.20	3938.15	0.11	979709.34	-165.0	-151.4	52470
BS95	39 20.58	118 51.42	3939.24	0.11	979711.23	-163.0	-149.5	52486
BS96	39 20.58	118 51.63	3937.44	0.11	979713.71	-160.6	-147.1	52496

Gravity and Magnetic Facts, Range Bravo 16.

Station ID	Latitude	Longitude	Elevation (ft)	T.C.	Observed Gravity	Complete Bouguer 2.67 gm/cc	Complete Bouguer 2.4 gm/cc	Corrected Magnetics (gammas)
BS97	39 20.58	118 51.85	3941.42	0.12	979716.06	-158.1	-144.5	52678
BS98	39 20.58	118 52.05	3938.39	0.11	979717.10	-157.2	-143.6	52678
BS99	39 20.72	118 52.18	3938.90	0.11	979717.22	-157.2	-143.7	52730
BS100	39 20.83	118 52.33	3941.76	0.11	979717.87	-156.6	-143.0	52667
BS101	39 20.85	118 52.52	3942.93	0.12	979718.85	-155.6	-142.0	52637
BS102	39 20.77	118 52.73	3942.16	0.12	979720.02	-154.3	-140.7	52675
BS103	39 20.65	118 52.92	3942.10	0.12	979720.85	-153.3	-139.7	52702
BS104	39 20.55	118 53.12	3942.72	0.12	979722.24	-151.7	-138.2	52696
BS105	39 20.50	118 53.37	3946.57	0.13	979722.57	-151.1	-137.5	52618
BS106	39 18.85	118 53.20	3951.46	0.17	979727.88	-143.0	-129.4	53228
BS107	39 18.85	118 52.93	3943.22	0.16	979726.66	-144.7	-131.1	52143
BS108	39 18.85	118 52.67	3940.03	0.15	979724.15	-147.4	-133.9	52501
BS109	39 18.85	118 52.37	3936.91	0.15	979721.43	-150.3	-136.8	52389
BS110	39 18.85	118 52.15	3936.19	0.15	979720.00	-151.8	-138.3	52347
BS111	39 18.87	118 51.93	3935.47	0.15	979718.85	-153.0	-139.5	52307
BS112	39 18.87	118 51.72	3935.17	0.16	979717.68	-154.2	-140.7	52361
BS113	39 18.87	118 51.50	3932.81	0.16	979716.23	-155.8	-142.3	52403
BS114	39 18.73	118 51.37	3932.42	0.16	979716.77	-155.7	-142.2	52378
BS115	39 18.57	118 51.37	3933.81	0.16	979716.68	-154.9	-141.3	52309
BS116	39 18.38	118 51.37	3932.78	0.16	979717.43	-153.9	-140.4	52299
BS117	39 18.22	118 51.35	3935.28	0.17	979718.39	-152.5	-139.0	52506
BS118	39 18.00	118 51.37	3933.41	0.16	979720.04	-150.7	-137.1	52713
BS119	39 17.83	118 51.37	3934.60	0.16	979720.19	-150.2	-136.7	52855
BS120	39 17.67	118 51.37	3940.16	0.15	979719.73	-150.1	-136.5	52905
BS121	39 17.50	118 51.38	3941.86	0.15	979719.31	-150.2	-136.6	52998
BS122	39 17.37	118 51.37	3943.08	0.15	979718.93	-150.3	-136.7	53076
BS123	39 20.75	118 51.22	3938.30	0.15	979709.54	-165.0	-151.4	52540
BS124	39 20.92	118 51.25	3938.44	0.14	979709.95	-164.8	-151.2	52552
BS125	39 21.08	118 51.30	3938.72	0.14	979710.45	-164.5	-151.0	52613
BS126	39 21.27	118 51.33	3939.34	0.14	979710.85	-164.4	-150.8	52647
BS127	39 21.42	118 51.40	3940.59	0.14	979711.40	-164.0	-150.4	52661
BS128	39 21.58	118 51.47	3942.38	0.14	979712.01	-163.5	-149.9	52669

Gravity and Magnetic Facts, Range Bravo 16.

Station ID	Latitude	Longitude	Elevation (ft)	T.C.	Observed Gravity	Complete Bouguer		Corrected Magnetics (gammas)
						2.67 gm/cc	2.4 gm/cc	
BS129	39 21.73	118 51.53	3942.47	0.14	979712.93	-162.8	-149.2	52713
BS130	39 21.88	118 51.62	3942.88	0.14	979713.70	-162.2	-148.6	52679
BS131	39 22.08	118 51.70	3949.46	0.10	979714.23	-161.6	-148.0	52648
BS132	39 22.23	118 51.75	3949.87	0.10	979714.82	-161.2	-147.6	52631
BS133	39 22.38	118 51.10	3950.12	0.10	979711.39	-164.9	-151.3	52743
BS134	39 22.40	118 50.82	3953.56	0.12	979709.96	-166.1	-152.5	52730
BS135	39 22.43	118 50.65	3957.46	0.23	979709.18	-166.6	-152.9	52767
BS136	39 22.40	118 50.35	3956.49	0.17	979708.45	-167.4	-153.8	52770
BS137	39 22.22	118 50.18	3951.94	0.11	979707.99	-167.9	-154.3	52830
BS138	39 21.97	118 50.17	3953.76	0.15	979706.96	-168.4	-154.8	52839
BS139	39 21.78	118 50.17	3941.68	0.15	979707.22	-168.6	-155.0	52763
BS140	39 21.62	118 50.17	3939.37	0.14	979706.73	-169.0	-155.4	52745
BS141	39 21.40	118 50.17	3940.82	0.15	979705.80	-169.5	-155.9	52711
BS142	39 21.15	118 50.17	3937.81	0.14	979705.18	-170.0	-156.4	52660
BS143	39 21.00	118 50.13	3939.80	0.15	979704.62	-170.2	-156.6	52653
BS144	39 20.87	118 50.15	3937.12	0.14	979704.57	-170.2	-156.6	52641
BS145	39 20.73	118 50.15	3935.91	0.14	979704.43	-170.2	-156.6	52603
BS146	39 21.40	118 53.28	3945.43	0.11	979720.08	-155.0	-141.4	52533
BS147	39 21.43	118 53.08	3945.64	0.11	979719.59	-155.5	-142.0	52639
BS148	39 21.48	118 52.87	3945.96	0.10	979719.95	-155.2	-141.6	52928
BS149	39 21.50	118 52.63	3945.85	0.10	979720.14	-155.1	-141.5	52881
BS150	39 21.48	118 52.43	3947.04	0.10	979718.99	-156.1	-142.5	52821
BS151	39 21.50	118 52.22	3944.13	0.15	979717.43	-157.8	-144.3	52744
BS152	39 21.50	118 52.00	3942.12	0.14	979715.50	-159.9	-146.3	52801
BS153	39 21.48	118 51.78	3941.59	0.14	979714.26	-161.1	-147.6	52743
BS154	39 21.47	118 51.57	3943.09	0.14	979712.49	-162.8	-149.2	52709
BS155	39 21.43	118 51.37	3940.51	0.14	979711.12	-164.3	-150.7	52642
BS156	39 21.42	118 51.17	3941.76	0.15	979709.60	-165.7	-152.1	52609
BS157	39 21.43	118 50.95	3941.87	0.15	879708.39	-166.9	-153.3	52647
BS158	39 21.42	118 50.73	3940.85	0.14	979707.42	-167.9	-154.4	52664
BS159	39 21.45	118 50.52	3941.00	0.14	979706.80	-168.6	-155.0	52732
BS160	39 21.47	118 50.33	3946.34	0.13	979706.05	-169.1	-155.5	52762

Gravity and Magnetic Facts, Range Bravo 16.

Station ID	Latitude	Longitude	Elevation (ft)	T.C.	Observed Gravity	Complete Bouguer		Corrected Magnetics (gammas)
						2.67 gm/cc	2.4 gm/cc	
BS161	39 21.27	118 53.70	3947.62	0.11	979721.23	-153.5	-139.9	52643
BS162	39 21.22	118 53.92	3957.11	0.12	979720.39	-153.7	-140.1	52575
BS163	39 21.22	118 54.12	3964.02	0.14	979720.17	-153.5	-139.8	52483
BS164	39 21.15	118 54.32	3974.22	0.14	979720.97	-152.0	-138.3	52416
BS165	39 21.12	118 54.53	3994.21	0.18	979720.54	-151.1	-137.4	52449
BS166	39 21.07	118 54.72	4022.42	0.17	979719.46	-150.4	-136.6	52792
BS167	39 21.03	118 54.92	4053.57	0.18	979717.05	-150.9	-137.0	52583
BS168	39 20.98	118 55.08	4083.46	0.20	979715.88	-150.2	-136.1	52734
BS169	39 20.88	118 55.15	4118.78	0.27	979714.03	-149.7	-135.5	52850
BS170	39 20.82	118 55.35	4114.98	0.19	979714.57	-149.4	-135.2	52847
BS171	39 20.73	118 55.52	4145.27	0.23	979712.02	-149.9	-135.7	52775
BS172	39 20.70	118 55.73	4173.38	0.28	979710.97	-149.2	-134.8	52810
BS173	39 20.55	118 55.62	4156.80	0.28	979711.21	-149.7	-135.4	53265
BS174	39 20.38	118 55.70	4199.00	0.55	979708.18	-149.6	-135.2	52994
BS175	39 20.28	118 55.60	4191.90	0.47	979709.35	-148.8	-134.4	52966
BS176	39 20.13	118 55.55	4191.91	0.35	979709.00	-149.1	-134.7	52852
BS177	39 19.98	118 55.48	4193.48	0.38	979708.87	-148.9	-134.5	52720
BS178	39 19.87	118 55.33	4195.04	0.38	979708.91	-148.6	-134.2	52620
BS179	39 19.75	118 55.23	4207.39	0.39	979710.17	-146.4	-131.9	52698
BS180	39 19.65	118 55.28	4227.38	0.33	979709.64	-145.7	-131.1	52738
BS181	39 19.45	118 55.30	4263.29	0.37	979709.86	-142.9	-128.3	52924
BS182	39 19.30	118 55.30	4239.15	0.29	979711.75	-142.4	-127.8	52374
BS183	39 19.17	118 55.33	4207.57	0.30	979713.05	-142.8	-128.3	52747
BS184	39 19.02	118 55.28	4154.95	0.23	979716.37	-142.5	-128.2	52777
BS185	39 18.87	118 55.18	4119.70	0.24	979718.81	-141.9	-127.7	52774
BS186	39 18.72	118 55.07	4110.03	0.33	979718.71	-142.3	-128.1	52791
BS187	39 18.58	118 54.98	4087.71	0.23	979719.61	-142.6	-128.6	52797
BS188	39 18.40	118 54.98	4064.09	0.29	979719.46	-143.8	-129.9	52752
BS189	39 18.33	118 54.88	4054.26	0.41	979718.98	-144.6	-130.7	52707
BS190	39 18.33	118 54.67	4039.71	0.36	979720.20	-144.4	-130.5	52708
BS191	39 18.38	118 54.48	4030.37	0.40	979720.94	-144.2	-130.4	52755
BS192	39 18.33	118 54.33	4049.41	0.42	979719.11	-144.8	-130.9	52819

Gravity and Magnetic Facts, Range Bravo 16.

Station ID	Latitude	Longitude	Elevation (ft)	T.C.	Observed Gravity	Complete Bouguer		Corrected Magnetics (gammas)
						2.67 gm/cc	2.4 gm/cc	
BS193	39 18.38	118 54.17	4012.16	0.22	979722.68	-143.8	-130.0	52866
BS194	39 18.37	118 53.97	3993.36	0.22	979723.62	-144.0	-130.2	52913
BS195	39 18.35	118 53.75	3989.79	0.19	979724.23	-143.6	-129.9	52914
BS196	39 18.43	118 53.57	3977.12	0.20	979725.54	-143.1	-129.5	53083
BS197	39 18.43	118 51.53	3933.19	0.16	979718.48	-152.9	-139.4	52447
BS198	39 18.33	118 51.67	3937.08	0.15	979719.80	-151.2	-137.6	52778
BS199	39 18.22	118 51.83	3934.33	0.16	979721.27	-149.7	-136.2	53054
BS200	39 18.10	118 52.00	3935.37	0.16	979722.00	-148.7	-135.2	53065
BS201	39 17.98	118 52.17	3935.86	0.18	979723.07	-147.5	-133.9	53106
BS202	39 17.87	118 52.30	3936.16	0.16	979723.71	-146.6	-133.1	53137
BS203	39 17.90	118 52.48	3942.15	0.18	979723.22	-146.8	-133.2	53018
BS204	39 17.82	118 52.60	3964.79	0.32	979721.52	-146.8	-133.2	52959
BS205	39 17.70	118 52.75	3947.86	0.20	979722.85	-146.5	-132.9	52873
BS206	39 19.73	118 55.03	4181.82	0.25	979713.91	-144.4	-130.0	53042
BS207	39 19.68	118 54.82	4155.17	0.22	979717.62	-142.2	-127.9	52591
BS208	39 19.68	118 54.60	4122.59	0.21	979718.85	-142.9	-128.8	52899
BS209	39 19.65	118 54.32	4078.61	0.33	979721.51	-142.7	-128.7	52340
BS210	39 19.70	118 54.18	4001.66	0.28	979725.52	-143.5	-129.7	52623
BS211	39 19.75	118 53.92	3974.42	0.23	979726.06	-144.7	-131.0	52787
BS212	39 19.82	118 53.70	3958.46	0.20	979725.78	-146.1	-132.4	52546

Appendix C

GRAVITY AND MAGNETIC FACTS
RANGE BRAVO 19

Latitude = degrees minutes.hundreths of a minute

Longitude = degrees minutes.hundreths of a minute

Elevation = feet above mean sea level

T.C. = terrain correction in milligals (hand picked through Hammer Zone M, using a density of 2.0 gm/cc)

Observed Gravity = milligals

Complete Bouguer = milligals, values reduced by using the Geodetic Reference System, 1967

Magnetics = ground magnetic value in gammas

Gravity and Magnetic Facts, Range Bravo 19.

Station ID	Latitude	Longitude	Elevation (ft)	T.C.	Observed Gravity	Complete Bouguer 2.67 gm/cc	Complete Bouguer 2.4 gm/cc	Magnetics (gammas)
BN1	39 08.52	118 40.73	3892.93	0.43	979684.05	-174.7	-161.4	52352
BN2	39 08.52	118 41.00	3890.62	0.42	979683.20	-175.7	-162.4	52298
BN3	39 08.52	118 41.27	3886.48	0.42	979682.61	-176.6	-163.2	52255
BN4	39 08.52	118 41.53	3886.77	0.42	979681.96	-177.2	-163.9	52228
BN5	39 08.52	118 41.82	3886.07	0.42	979681.75	-177.5	-164.1	52262
BN6	39 08.52	118 42.03	3884.12	0.44	979681.98	-177.3	-164.0	52279
BN7	39 08.52	118 42.27	3891.62	0.43	979681.68	-177.2	-163.8	52280
BN8	39 08.52	118 42.48	3905.77	0.42	979681.17	-176.9	-163.4	52290
BN9	39 08.52	118 42.75	3922.99	0.40	979680.82	-176.2	-162.7	52325
BN10	39 08.52	118 42.97	3937.35	0.38	979680.76	-175.4	-161.9	52376
BN11	39 08.52	118 43.18	3951.88	0.39	979680.81	-174.5	-160.9	52461
BN12	39 08.52	118 43.40	3968.47	0.39	979680.73	-173.6	-159.9	52449
BN13	39 08.52	118 43.62	3984.18	0.41	979680.83	-172.5	-158.8	52450
BN14	39 08.52	118 43.83	3999.18	0.43	979681.13	-171.3	-157.6	52485
BN15	39 08.52	118 44.03	4025.61	0.42	979680.77	-170.1	-156.2	52450
BN16	39 08.70	118 44.12	4025.47	0.43	979681.04	-170.1	-156.2	52489
BN17	39 08.88	118 44.12	3998.05	0.46	979683.21	-169.8	-156.0	52500
BN18	39 09.12	118 44.12	3979.98	0.43	979684.68	-169.8	-156.1	52549
BN19	39 09.28	118 44.12	3987.26	0.45	979684.42	-169.8	-156.1	52592
BN20	39 09.43	118 44.13	3989.21	0.46	979684.68	-169.6	-156.0	52661
BN21	39 09.60	118 44.13	3979.02	0.53	979686.20	-168.9	-155.2	52952
BN22	39 09.72	118 44.13	3964.60	0.51	979687.79	-168.4	-154.8	52979
BN23	39 09.87	118 44.13	3939.06	0.55	979690.04	-167.8	-154.3	52711
BN24	39 10.02	118 44.13	3933.54	0.55	979690.94	-167.5	-154.0	52857
BN25	39 10.18	118 44.13	3890.68	0.61	979694.72	-166.4	-153.1	52971
BN26	39 10.32	118 44.13	3900.41	0.60	979694.78	-166.0	-152.6	53172
BN27	39 10.52	118 44.13	3889.63	0.55	979696.95	-164.8	-151.5	52708
BN28	39 08.68	118 42.72	3912.39	0.41	979681.75	-176.1	-162.7	52281
BN29	39 08.80	118 42.63	3902.08	0.43	979682.62	-176.0	-162.6	52219
BN30	39 08.88	118 42.45	3887.49	0.43	979683.66	-176.0	-162.6	52203

Gravity and Magnetic Facts, Range Bravo 19.

Station ID	Latitude	Longitude	Elevation (ft)	T.C.	Observed Gravity	Complete Bouguer 2.67 gm/cc	Complete Bouguer 2.4 gm/cc	Magnetics (gammas)
BN31	39 09.02	118 42.32	3899.09	0.44	979683.53	-175.6	-162.2	52200
BN32	39 09.18	118 42.17	3881.57	0.45	979686.18	-174.2	-160.9	52217
BN33	39 09.20	118 42.33	3906.45	0.40	979684.38	-174.6	-161.2	52155
BN34	39 09.20	118 42.55	3898.57	0.43	979684.89	-174.6	-161.2	52094
BN35	39 09.20	118 42.75	3913.00	0.41	979684.01	-174.6	-161.2	52091
BN36	39 09.20	118 42.97	3920.78	0.47	979683.89	-174.2	-160.7	52223
BN37	39 09.20	118 43.22	3910.94	0.42	979685.19	-173.5	-160.1	52454
BN38	39 09.20	118 43.45	3914.40	0.46	979685.50	-173.0	-159.5	52446
BN39	39 09.20	118 43.65	3932.00	0.55	979684.95	-172.3	-158.9	52402
BN40	39 09.20	118 43.90	3954.87	0.46	979684.85	-171.2	-157.6	52513
BN41	39 09.20	118 44.10	3974.94	0.48	979685.05	-169.8	-156.1	52603
BN42	39 09.08	118 43.27	3919.73	0.43	979684.08	-173.9	-160.5	52463
BN43	39 08.95	118 43.28	3934.31	0.40	979682.83	-174.2	-160.6	52476
BN44	39 08.82	118 43.42	3948.96	0.41	979681.95	-173.9	-160.4	52478
BN45	39 08.63	118 43.48	3965.83	0.40	979681.09	-173.5	-159.9	52510
BN46	39 09.38	118 42.12	3884.94	0.43	979687.98	-172.6	-159.2	52299
BN47	39 09.57	118 42.05	3882.98	0.44	979690.31	-170.6	-157.3	52426
BN48	39 09.70	118 42.00	3889.80	0.45	979691.84	-168.8	-155.5	52469
BN49	39 09.82	118 41.93	3911.42	0.42	979692.19	-167.4	-154.0	52449
BN50	39 09.95	118 41.83	3934.24	0.44	979693.04	-165.4	-151.9	52429
BN51	39 10.03	118 41.58	3922.49	0.50	979696.35	-162.8	-149.3	52619
BN52	39 10.15	118 41.45	3955.06	0.53	979695.97	-161.4	-147.8	52625
BN53	39 10.23	118 41.28	3950.04	0.62	979698.04	-159.6	-146.1	52755
BN54	39 10.32	118 41.15	3995.26	0.67	979696.38	-158.6	-144.9	52719
BN55	39 10.40	118 41.12	4021.42	0.73	979695.86	-157.6	-143.8	52135
BN58	39 11.67	118 41.13	4370.95	0.90	979683.34	-150.8	-135.9	52842
BN59	39 11.52	118 41.13	4319.09	0.71	979685.67	-151.6	-136.8	52788
BN60	39 11.38	118 41.15	4276.51	0.66	979687.35	-152.4	-137.7	52596
BN61	39 11.17	118 41.15	4243.88	0.65	979687.61	-153.7	-139.2	53084
BN62	39 10.98	118 41.13	4174.24	0.68	979691.03	-154.2	-139.9	52928

Gravity and Magnetic Facts, Range Bravo 19.

Station ID	Latitude	Longitude	Elevation (ft)	T.C.	Observed Gravity	Complete Bouguer		Magnetics (gammas)
						2.67 gm/cc	2.4 gm/cc	
BN63	39 10.75	118 41.15	4107.17	0.70	979693.48	-155.4	-141.3	53058
BN65	39 10.53	118 41.23	4033.31	0.73	979695.80	-157.1	-143.3	53136
BN66	39 10.32	118 41.25	3976.86	0.83	979697.45	-158.4	-144.8	52904
BN67	39 09.82	118 42.17	3882.60	0.46	979692.79	-168.5	-155.2	52455
BN68	39 10.00	118 42.18	3887.66	0.49	979694.59	-166.7	-153.4	52494
BN69	39 10.00	118 42.42	3883.53	0.45	979694.59	-166.9	-153.6	52433
BN70	39 09.98	118 42.62	3881.99	0.44	979693.19	-168.4	-155.1	52271
BN71	39 09.98	118 42.85	3881.24	0.45	979692.96	-168.7	-155.3	52051
BN72	39 10.05	118 42.98	3882.67	0.45	979693.47	-168.2	-154.8	52106
BN73	39 10.13	118 43.22	3883.24	0.46	979693.85	-167.9	-154.5	52331
BN74	39 10.22	118 43.45	3881.71	0.47	979694.69	-167.2	-153.9	52240
BN75	39 10.23	118 43.65	3882.08	0.50	979695.08	-166.8	-153.5	51891
BN76	39 10.25	118 43.88	3882.76	0.52	979695.29	-166.5	-153.2	52952
BN77	39 10.10	118 43.93	3887.14	0.54	979694.23	-167.1	-153.8	52735
BN78	39 10.52	118 44.20	3893.11	0.60	979696.94	-164.6	-151.2	52774
BN79	39 10.70	118 44.23	3893.18	0.58	979698.20	-163.6	-150.2	52662
BN80	39 10.87	118 44.28	3893.86	0.59	979699.19	-162.8	-149.4	52727
BN81	39 11.00	118 44.20	3894.70	0.53	979699.68	-162.5	-149.2	52643
BN82	39 11.13	118 44.12	3909.29	0.49	979699.47	-162.1	-148.7	52465
BN83	39 11.20	118 43.92	3925.25	0.44	979699.31	-161.5	-148.0	52273
BN84	39 11.27	118 43.80	3925.93	0.48	979699.91	-160.9	-147.4	52357
BN85	39 11.22	118 43.60	3907.69	0.49	979700.65	-161.1	-147.7	52470
BN86	39 11.23	118 43.38	3904.05	0.52	979701.95	-160.1	-146.7	52179
BN87	39 11.28	118 43.15	3930.85	0.58	979701.93	-158.5	-145.0	51509
BN88	39 11.33	118 42.97	3965.09	0.67	979701.14	-157.2	-143.6	50892
BN89	39 11.47	118 42.82	4045.39	0.94	979697.68	-155.6	-141.8	53105
BN90	39 11.38	118 42.57	4030.30	0.64	979700.09	-154.4	-140.6	50841
BN91	39 11.37	118 42.38	4032.62	0.74	979701.69	-152.5	-138.7	52772
BN92	39 11.42	118 42.18	4076.87	0.63	979701.10	-150.7	-136.7	53208
BN93	39 11.50	118 42.00	4135.28	0.57	979698.30	-150.2	-136.0	53136

Gravity and Magnetic Facts, Range Bravo 19.

Station ID	Latitude	Longitude	Elevation (ft)	T.C.	Observed Gravity	Complete Bouguer		Magnetics (gammas)
						2.67 gm/cc	2.4 gm/cc	
BN94	39 11.55	118 41.87	4174.22	0.74	979696.73	-149.2	-135.0	53094
BN95	39 11.62	118 41.63	4269.59	0.55	979689.88	-150.7	-136.1	52994
BN96	39 11.53	118 41.43	4297.89	0.54	979687.91	-150.9	-136.2	52910
BN97	39 11.37	118 41.40	4248.98	0.82	979689.25	-151.9	-137.3	52954
BN98	39 11.20	118 41.72	4218.45	0.73	979689.75	-153.1	-138.6	52400
BN99	39 11.12	118 41.20	4224.39	0.64	979688.33	-154.1	-139.7	52973
BN100	39 11.22	118 42.92	3939.22	0.57	979701.53	-158.3	-144.8	52398
BN101	39 11.10	118 42.90	3920.76	0.51	979701.74	-159.1	-145.6	51855
BN102	39 10.88	118 42.95	3930.37	0.42	979698.69	-161.4	-147.9	52219
BN103	39 10.72	118 42.93	3910.48	0.45	979698.38	-162.6	-149.2	51961
BN104	39 10.55	118 42.98	3884.42	0.47	979698.29	-164.0	-150.6	52077
BN105	39 10.40	118 43.02	3885.79	0.45	979696.38	-165.6	-152.2	52102
BN106	39 10.25	118 43.00	3883.17	0.45	979695.15	-166.8	-153.4	52087
BN107	39 10.03	118 43.05	3892.85	0.43	979692.41	-168.6	-155.2	52161
BN108	39 09.92	118 43.08	3901.24	0.43	979690.79	-169.6	-156.2	52158
BN109	39 09.77	118 43.13	3909.17	0.41	979688.99	-170.7	-157.3	52229
BN110	39 09.62	118 43.18	3906.78	0.41	979687.98	-171.6	-158.2	52424
BN111	39 09.43	118 43.17	3906.07	0.43	979686.71	-172.6	-159.2	52421
BN112	39 09.30	118 43.20	3903.32	0.44	979686.28	-173.0	-159.6	52448
BN113	39 11.40	118 43.12	4007.94	0.80	979698.50	-157.1	-143.4	51875
BN114	39 11.55	118 43.15	4066.93	0.73	979695.39	-157.0	-143.1	53823
BN115	39 11.77	118 43.15	4122.49	0.77	979694.19	-155.2	-141.1	53603
BN116	39 11.92	118 43.18	4144.24	0.65	979695.48	-153.0	-138.8	53247
BN117	39 11.90	118 43.37	4237.49	0.87	979688.04	-154.5	-140.0	52178
BN118	39 12.07	118 43.40	4209.07	0.49	979692.08	-152.9	-138.5	53273
BN119	39 12.07	118 43.58	4205.66	0.64	979690.19	-154.8	-140.4	52850
BN120	39 11.97	118 43.68	4239.86	1.02	979685.89	-156.4	-141.9	51388
BN121	39 11.90	118 43.90	4206.33	0.73	979685.85	-158.7	-144.3	53546
BN122	39 11.90	118 43.98	4181.78	0.75	979688.27	-157.8	-143.4	52371
BN123	39 11.90	118 44.13	4020.41	0.77	979698.91	-156.8	-143.0	52935

Gravity and Magnetic Facts, Range Bravo 19.

Station ID	Latitude	Longitude	Elevation (ft)	T.C.	Observed Gravity	Complete Bouguer		Magnetics (gammas)
						2.67 gm/cc	2.4 gm/cc	
BN124	39 11.97	118 44.30	3951.50	0.56	979704.67	-155.5	-142.0	52009
BN125	39 11.78	118 44.28	3946.55	0.54	9797202.32	-157.9	-144.4	51722
BN126	39 11.58	118 44.32	3948.66	0.50	979700.03	-159.8	-146.3	53141
BN127	39 11.45	118 44.33	3944.12	0.51	979699.41	-160.5	-147.0	52839
BN128	39 11.27	118 44.33	3929.30	0.52	979699.15	-161.4	-147.9	52727
BN129	39 11.13	118 44.30	3927.70	0.51	979698.38	-162.1	-148.6	52698
BN130	39 11.00	118 44.32	3900.70	0.57	979699.58	-162.2	-148.8	52736
BN131	39 09.20	118 41.95	3883.24	0.44	979686.45	-173.9	-160.6	52258
BN132	39 09.20	118 41.75	3883.03	0.44	979687.23	-173.1	-159.8	52256
BN133	39 09.22	118 41.50	3881.79	0.45	979688.61	-171.8	-158.5	52215
BN134	39 09.12	118 41.23	3883.46	0.45	979688.34	-171.9	-158.5	52269
BN135	39 09.15	118 41.05	3883.54	0.48	979689.75	-170.5	-157.1	52248
BN136	39 09.20	118 40.85	3889.38	0.47	979691.09	-168.9	-155.5	52227
BN137	39 09.22	118 40.60	3904.08	0.51	979691.11	-167.9	-154.5	52416
BN138	39 09.22	118 40.30	3905.29	0.53	979692.52	-166.4	-153.0	52426
BN139	39 09.22	118 40.08	3930.47	0.54	979691.94	-165.5	-152.0	52378
BN140	39 09.22	118 39.87	3943.05	0.55	979691.58	-165.1	-151.6	52966
BN141	39 09.22	118 39.67	3964.72	0.53	979690.47	-164.9	-151.3	52994
BN142	39 09.22	118 39.47	3983.29	0.55	979689.74	-164.5	-150.8	52786
BN143	39 09.22	118 39.25	4000.04	0.54	979689.36	-163.9	-150.2	52892
BN144	39 09.22	118 39.02	4019.15	0.64	979688.74	-163.2	-149.5	52878
BN145	39 09.22	118 38.78	4053.68	0.62	979687.16	-162.8	-148.9	52847
BN146	39 09.15	118 38.62	4083.04	0.54	979685.07	-163.1	-149.1	52794
BN147	39 09.05	118 38.60	4070.77	0.53	979685.29	-163.5	-149.5	52777
BN148	39 08.87	118 38.62	4013.66	0.57	979687.58	-164.3	-150.5	52748
BN149	39 08.75	118 38.62	3989.63	0.54	979688.28	-164.9	-151.2	52716
BN150	39 08.52	118 38.55	4011.15	0.45	979685.28	-166.4	-152.6	52714
BN151	39 08.52	118 38.78	3971.42	0.57	979686.97	-166.9	-153.3	52791
BN152	39 08.52	118 39.02	3944.83	0.43	979687.84	-167.8	-154.3	52773

Gravity and Magnetic Facts, Range Bravo 19.

Station ID	Latitude	Longitude	Elevation (ft)	T.C.	Observed Gravity	Complete Bouguer		Magnetics (gammas)
						2.67 gm/cc	2.4 gm/cc	
BN153	39 03.52	118 39.27	3931.34	0.44	979687.60	-168.9	-155.4	52695
BN154	39 08.55	118 39.50	3924.45	0.43	979687.32	-169.6	-156.1	52660
BN155	39 08.57	118 39.72	3895.67	0.47	979688.45	-170.2	-156.8	52596
BN156	39 08.53	118 39.92	3892.59	0.45	979687.55	-171.3	-157.9	52524
BN157	39 08.52	118 40.13	3896.17	0.44	979686.33	-172.2	-158.9	52470
BN158	39 08.52	118 40.35	3895.79	0.43	979685.40	-173.2	-159.8	52400
BN159	39 08.52	118 40.58	3893.84	0.43	979684.64	-174.1	-160.7	52344

Appendix D

THERMAL GRADIENT DATA, NAS FALLON, RANGE BRAVO 16 AND RANGE BRAVO 19

Observation Hole, NAS Fallon
(14 December 1981, Ambient = 60°F)

Depth*	°F
0	60
100	68
200	77
300	87
400	96
500	105
600	115
700	123
800	132
900	144
1000	153
1025	156
1050	157.6
1075	158.5
1100	158.5
1125	158.3
1150	158
1175	157.9
1200	157.9
1225	159.1
1250	161
1275	162
1300	164
1400	169
1500	174
1600	180
1700	186
1800	191
1900	198
2000	205
2025	206

*Feet below surface.

Total depth = 2025 feet (617.22 m)
Bottom temperature = 206°F (96.67°C)
Mean air temperature = 53°F
Geothermal gradient = 7.56°F/100 feet
(13.77°C/100 m)

Well O, NAS Fallon
(16 January 1982, Ambient = 48°F)

Depth*	°F
100	65
200	69
300	74
400	78
500	82
600	86
700	90
800	93
900	97
1000	100
1100	106
1200	110
1300	116
1400	120
1500	124
1600	127
1700	129
1800	130

*Feet below surface.

Total depth = 1800 feet (548.64 m)
Bottom temperature = 130°F (54.44°C)
Mean air temperature = 53°F
Geothermal gradient = 4.28°F/100 feet
(7.80°C/100 m)

Thermal Gradient Hole 20, Range Bravo 19
(28 November 1979, Ambient = 42°F)

Depth*	°F
0	42
7.5	43
12.5	62
35	61
50	62
90	63
130	64
177.5	65
205	66
237.5	67
267.5	68
290	69
317.5	70
355	71
380	72
405	73
442.5	74
457.5	75
475	76

*Feet below surface.

Total depth = 475 feet (144.78 m)
Bottom temperature = 76°F (24.44°C)
Mean air temperature = 53°F
Geothermal gradient = 4.84°F/100 feet
(8.82°C/100 m)

Thermal Gradient Hole 21, Range Bravo 19
(28 November 1979, Ambient = 40°F)

Depth*	°F
0	41
10	42
12.5	43
17.5	44
20	45
22.5	46
25	50
27.5	51
30	52
32.5	54
37.5	55
40	57
42.5	58
50	59
62.5	60
92.5	61
95	65
115	66
157.5	67
197.5	68
235	69
272.5	70
312.5	71
352.5	72
380	73
410	74
442.5	75

*Feet below surface.

Total depth = 450 feet (137.16 m)
Bottom temperature = 75°F (23.89°C)
Mean air temperature = 53°F
Geothermal gradient = 4.89°F/100 feet
(8.91°C/100 m)

Thermal Gradient Hole 22, Range Bravo 19
(28 November 1979, Ambient = 50°F)

Depth*	°F
0	51
12.5	52
15	59
17.5	60
20	61
30	62
67.5	63
87.5	64
107.5	65
135	66
165	67
187.5	68
215	69
240	70
277.5	71
302.5	72
325	73
355	74
385	75
410	76
432.5	77
457.5	78
485	79

*Feet below surface.

Total depth = 505 feet (153.92 m)
Bottom temperature = 79°F (26.11°C)
Mean air temperature = 53°F
Geothermal gradient = 5.15°F/100 feet
(9.38°C/100 m)

Thermal Gradient Hole 23, NAS Fallon
(26 November 1979, Ambient = 41°F)

Depth*	°F
0	42
5	59
7.5	60
10	61
15	62
22.5	60
57.5	61
80	62
105	63
135	64
165	65
185	66
200	67
225	68
242.5	69
260	70
280	71
292.5	72
315	73
322.5	74
350	75
365	76
397.5	77
402.5	78
417.5	79
437.5	80

*Feet below surface.

Total depth = 440 feet (134.11 m)
Bottom temperature = 80°F (26.67°C)
Mean air temperature = 53°F
Geothermal gradient = 6.14°F/100 feet
(11.19°C/100 m)

Thermal Gradient Hole 24, NAS Fallon
(26 November 1979, Ambient = 38°F)

Depth*	°F	Depth*	°F
0	39	217.5	85
2.5	56	227.5	86
5	57	235	87
7.5	59	245	88
10	61	252.5	89
40	62	260	90
47.5	64	267.5	91
60	65	275	92
70	66	285	93
80	67	292.5	94
92.5	68	300	95
97.5	69	307.5	96
102.5	70	317.5	97
117.5	71	325	98
122.5	72	335	99
127.5	73	345	100
137.5	74	352.5	101
145	75	360	102
152.5	76	370	103
160	77	380	104
167.5	78	387.5	105
175	79	397.5	106
182.5	80	405	107
190	81	415	108
197.5	82	425	109
200	83		
207.5	84		

*Feet below surface.

Total depth = 432.5 feet (131.83 m)
Bottom temperature = 109°F (42.78°C)
Mean air temperature = 53°F
Geothermal gradient = 12.95°F/100 feet
(23.60°C/100 m)

Thermal Gradient Hole 25, NAS Fallon
(26 November 1979, Ambient = 45°F)

Depth*	°F
0	46
2.5	49
5	52
7.5	55
10	56
15	57
17.5	58
30	57
57.5	58
77.5	59
95	60
122.5	61
140	62
162.5	63
190	64
220	65
240	66
257.5	67
282.5	68
297.5	69
315	70
340	71
355	72
365	73

*Feet below surface.

Total depth = 380 feet (115.82 m)
Bottom temperature = 73°F (22.78°C)
Mean air temperature = 53°F
Geothermal gradient = 5.26°F/100 feet
(9.60°C/100 m)

Thermal Gradient Hole 26, NAS Fallon
(26 November 1979, Ambient = 36°F)

Depth*	°F	Depth*	°F
0	43	247.5	78
2.5	48	257.5	79
5	54	267.5	80
7.5	56	277.5	81
10	58	285	82
12.5	59	295	83
15	60	305	84
20	59	317.5	85
45	60	332.5	86
55	61	342.5	87
65	62	355	88
75	63	367.5	89
82.5	64	375	90
92.5	65	385	91
107.5	66	395	92
127.5	67	407.5	93
145	68	420	94
155	69	430	95
162.5	70	440	96
177.5	71	450	97
182.5	72	460	98
192.5	73	467.5	99
202.5	74	480	100
210	75	490	101
222.5	76	502.5	102
235	77		

*Feet below surface.

Total depth = 505 feet (153.92 m)
Bottom temperature = 102°F (38.89°C)
Mean air temperature = 53°F
Geothermal gradient = 9.70°F/100 feet
(17.69°C/100 m)

Thermal Gradient Hole 27, NAS Fallon
(26 November 1979, Ambient = 38°F)

Depth*	°F
0	39
10	61
20	60
35	59
65	60
92.5	61
120	62
145	63
165	64
185	65
205	66
225	67
247.5	68
267.5	69
287.5	70
307.5	71
330	72
355	73
375	74
395	75
410	76
430	77
455	78
477.5	79
497.5	80

*Feet below surface.

Total depth = 505 feet (153.92 m)
Bottom temperature = 80°F (26.67°C)
Mean air temperature = 53°F
Geothermal gradient = 5.35°F/100 feet
(9.75°C/100 m)

Thermal Gradient Hole 28, NAS Fallon
(26 November 1979, Ambient = 42°F)

Depth*	°F
0	42
5	43
7.5	46
10	61
20	60
40	59
50	60
70	61
85	62
115	63
137.5	64
160	65
177.5	66
195	67
217.5	68
235	69
267.5	70
287.5	71
310	72
332.5	73
347.5	74
372.5	75
392.5	76
412.5	77
432.5	78
455	79

*Feet below surface.

Total depth = 455 feet (138.68 m)
Bottom temperature = 79°F (26.11°C)
Mean air temperature = 53°F
Geothermal gradient = 5.71°F/100 feet
(10.41°C/100 m)

Thermal Gradient Hole 29, NAS Fallon
(26 November 1979, Ambient = 34°F)

Depth*	°F
0	40
7.5	60
10	61
15	60
17.5	59
25	58
37.5	59
55	60
82.5	61
102.5	62
127.5	63
147.5	64
160	65
187.5	66
215	67
235	68
247.5	69
270	70
295	71
310	72
350	73
365	74
385	75
405	76
425	77
447.5	78
465	79
482.5	80
505	81

*Feet below surface.

Total depth = 510 feet (155.45 m)
Bottom temperature = 81°F (27.22°C)
Mean air temperature = 53°F
Geothermal gradient = 5.49°F/100 feet
(10.01°C/100 m)

Thermal Gradient Hole 30, NAS Fallon
(26 November 1979, Ambient = 40°F)

Depth*	°F
0	40
2.5	42
5	43
10	44
12.5	61
15	62
27.5	61
60	62
87.5	63
117.5	64
142.5	65
172.5	66
197.5	67
217.5	68
240	69
262.5	70
292.5	71
300	72
325	73
350	74
370	75
392.5	76
412.5	77
432.5	78
452.5	79
470	80
495	81

*Feet below surface.

Total depth = 505 feet (153.92 m)
Bottom temperature = 81°F (27.22°C)
Mean air temperature = 53°F
Geothermal gradient = 5.54°F/100 feet
(10.10°C/100 m)

Thermal Gradient Hole 31, NAS Fallon
(26 November 1979, Ambient = 41°F)

Depth*	°F
0	41
7.5	62
20	61
30	60
50	61
65	62
85	63
110	64
142.5	65
170	66
200	67
220	68
237.5	69
262.5	70
292.5	71
310	72
342.5	73
372.5	74
392.5	75
412.5	76
435	77
457.5	78
482.5	79

*Feet below surface.

Total depth = 500 feet (152.40 m)
Bottom temperature = 79°F (26.11°C)
Mean air temperature = 53°F
Geothermal gradient = 5.20°F/100 feet
(9.48°C/100 m)

Thermal Gradient Hole 32, Range Bravo 16
(27 November 1979, Ambient = 31°F)

Depth*	°F
0	36
2.5	42
5	48
7.5	54
10	57
12.5	60
15	61
17.5	62
20	63
27.5	62
50	63
90	64
140	65
177.5	66
252.5	67
295	68
330	69
352.5	70
397.5	71
422.5	72
457.5	73
482.5	74

*Feet below surface.

Total depth = 495 feet (150.88 m)
Bottom temperature = 74°F (23.33°C)
Mean air temperature = 53°F
Geothermal gradient = 4.24°F/100 feet
(7.73°C/100 m)

Thermal Gradient Hole 33, Range Bravo 16
(27 November 1979, Ambient = 20°F)

Depth*	°F
0	20
2.5	51
5	57
7.5	61
10	64
12.5	65
17.5	63
25	62
27.5	61
70	62
100	63
145	64
182.5	65
227.5	66
252.5	67
280	68
297.5	69
315	70

*Feet below surface.

Total depth = 317.5 feet (96.77 m)
Bottom temperature = 70°F (21.11°C)
Mean air temperature = 53°F
Geothermal gradient = 5.35°F/100 feet
(9.76°C/100 m)

Thermal Gradient Hole 34, Range Bravo 16
(27 November 1979, Ambient = 22°F)

Depth*	°F
0	23
2.5	24
7.5	25
10	61
12.5	62
15	63
25	62
40	63
62.5	64
107.5	65
145	66
172.5	67
207.5	68
230	69
257.5	70
292.5	71
330	72
350	73
387.5	74
417.5	75
450	76
477.5	77

*Feet below surface.

Total depth = 500 feet (152.40 m)
Bottom temperature = 77°F (25.00°C)
Mean air temperature = 53°F
Geothermal gradient = 4.80°F/100 feet
(8.75°C/100 m)

Thermal Gradient Hole 35, Range Bravo 16
(27 November 1979, Ambient = 29°F)

Depth*	°F
0	31
2.5	32
5	48
7.5	52
10	58
15	59
20	60
40	62
45	63
52.5	64
67.5	65
102.5	66
130	67
157.5	68
180	69
212.5	70
250	71
260	72
285	73
322.5	74
357.5	75
395	76
425	77
460	78

*Feet below surface.

Total depth = 467.5 feet (142.49 m)
Bottom temperature = 78°F (25.56°C)
Mean air temperature = 53°F
Geothermal gradient = 5.35°F/100 feet
(9.75°C/100 m)

Thermal Gradient Hole 36, Range Bravo 16
(27 November 1979, Ambient = 32°F)

Depth*	°F
0	35
5	37
7.5	38
10	39
12.5	41
15	42
17.5	59
20	60
22.5	61
25	62
32.5	63
50	64
80	65
110	66
150	67
185	68
215	69
240	70
277.5	71
312.5	72
337.5	73
372.5	74
410	75
440	76
467.5	77
495	78

*Feet below surface.

Total depth = 495 feet (150.88 m)
Bottom temperature = 78°F (25.56°C)
Mean air temperature = 53°F
Geothermal gradient = 5.05°F/100 feet
(9.21°C/100 m)

AD-A118 686 NAVAL WEAPONS CENTER CHINA LAKE CA F/G 8/7
EVALUATION OF GEOTHERMAL POTENTIAL OF THE NAVAL AIR WEAPONS TRA--ETC(U)
APR 82 A M KATZENSTEIN, K J DANTI
UNCLASSIFIED NWC-TP-6359 NL

2 of 2
AD
A118686

END
DATE
FILMED
9 82
DTIC

Thermal Gradient Hole 37, Range Bravo 16
(27 November 1979, Ambient = 31°F)

Depth*	°F
0	32
2.5	33
7.5	35
10	60
12.5	61
15	62
42.5	63
82.5	64
115	65
167.5	66
212.5	67
272.5	68
292.5	69
310	70
352.5	71
397.5	72
435	73
467.5	74
500	75

*Feet below surface.

Total depth = 500 feet (152.40 m)
Bottom temperature = 75°F (23.89°C)
Mean air temperature = 53°F
Geothermal gradient = 4.40°F/100 feet
(8.02°C/100 m)

Thermal Gradient Hole 38, Range Bravo 16
(27 November 1979, Ambient = 31°F)

Depth*	°F
0	37
7.5	38
10	41
12.5	54
15	57
17.5	59
20	60
27.5	61
37.5	62
57.5	63
77.5	64
102.5	65
147.5	66
177.5	67
207.5	68
230	69
262.5	70
302.5	71
312.5	72
345	73
365	74
395	75
422.5	76
450	77
480	78
502.5	79

*Feet below surface.

Total depth = 507.5 feet (154.69 m)
Bottom temperature = 79°F (26.11°C)
Mean air temperature = 53°F
Geothermal gradient = 5.12°F/100 feet
(9.34°C/100 m)

Thermal Gradient Hole 39, Range Bravo 19
(28 November 1979, Ambient = 34°F)

Depth*	°F
0	44
2.5	45
5	54
7.5	59
10	63
12.5	65
15	66
27.5	65
35	64
60	65
67.5	64
157.5	65
232.5	66
290	67
345	68
390	69
430	70
512.5	71
550	72

*Feet below surface.

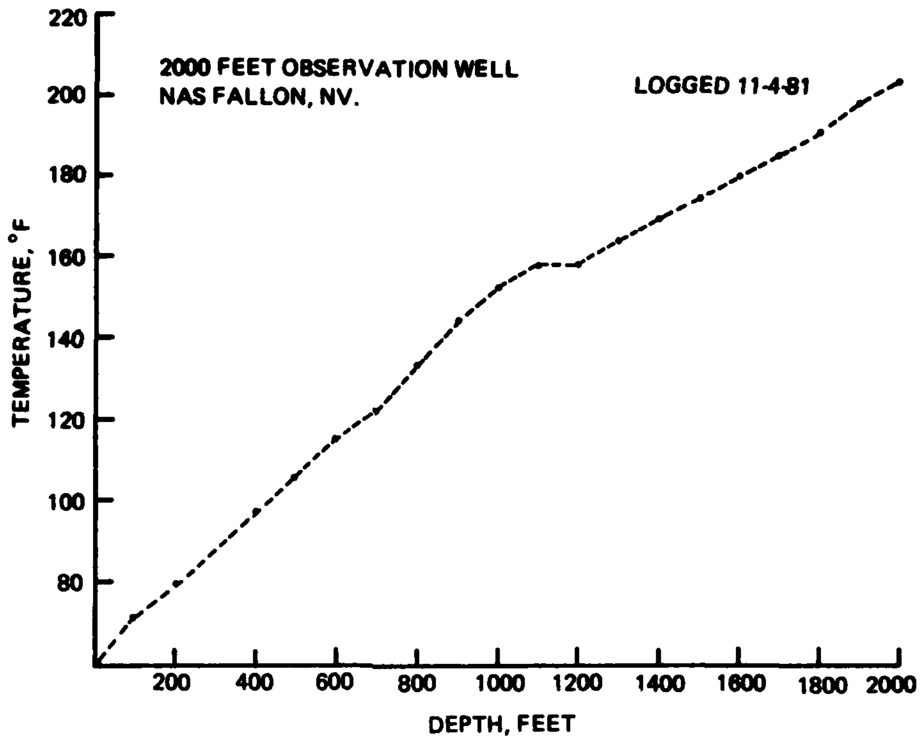
Total depth = 555 feet (169.16 m)
Bottom temperature = 72°F (22.22°C)
Mean air temperature = 53°F
Geothermal gradient = 3.42°F/100 feet
(6.24°C/100 m)

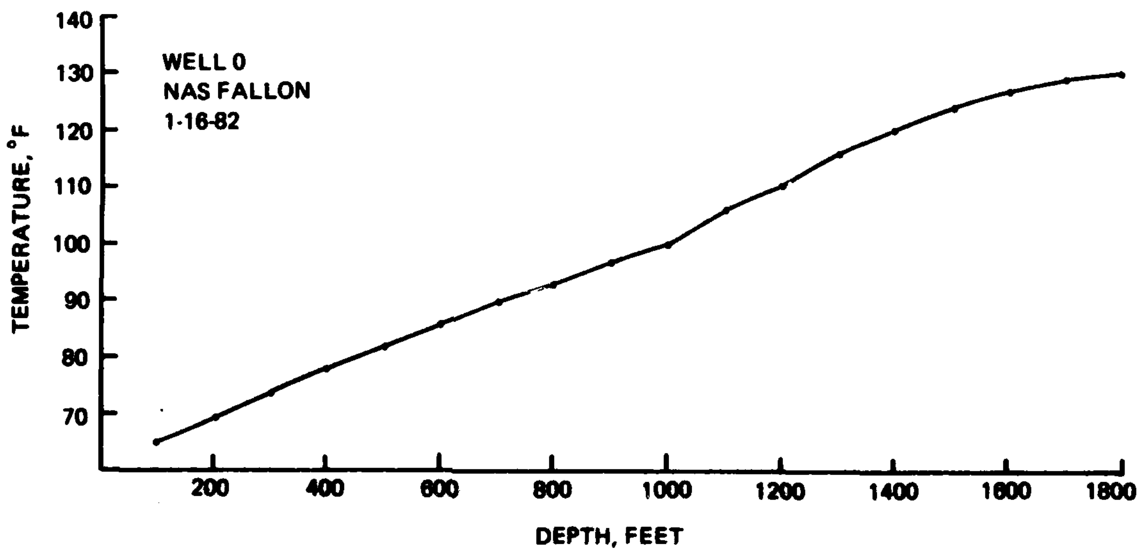
Thermal Gradient Hole 40, Range Bravo 19
(28 November 1979, Ambient = 37°F)

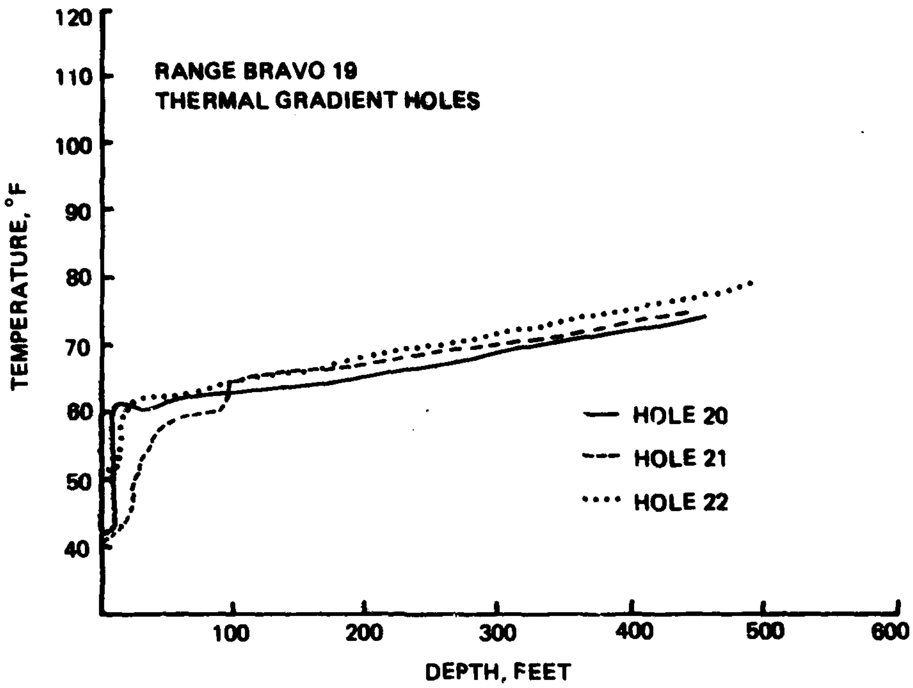
Depth*	°F
0	38
2.5	41
15	42
17.5	43
20	44
22.5	55
25	59
27.5	60
30	61
37.5	62
50	63
70	64
127.5	65
175	66
235	67
270	68
317.5	69
355	70
415	71
450	72
477.5	73
525	74

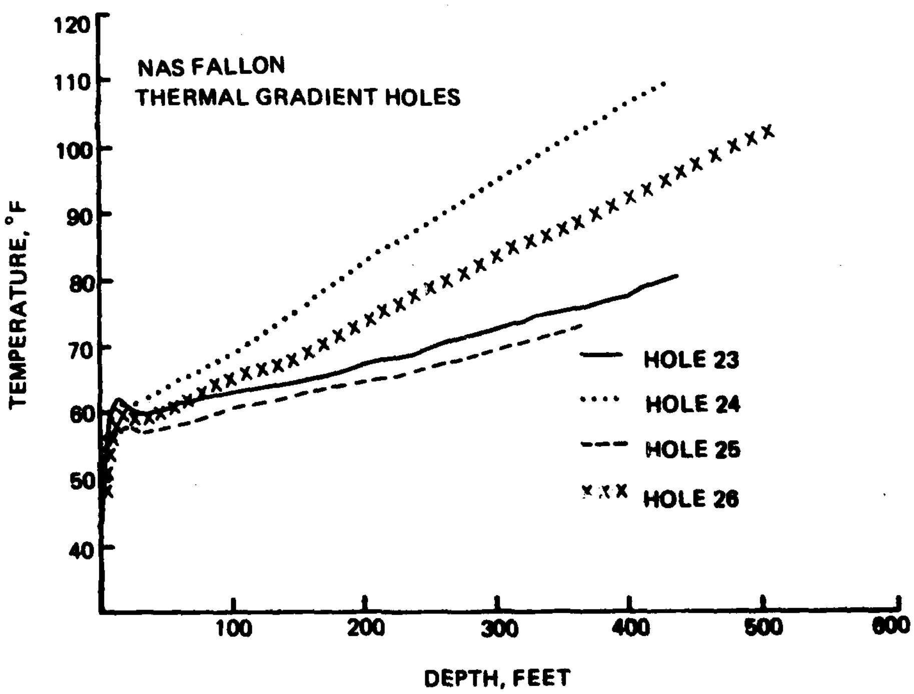
*Feet below surface.

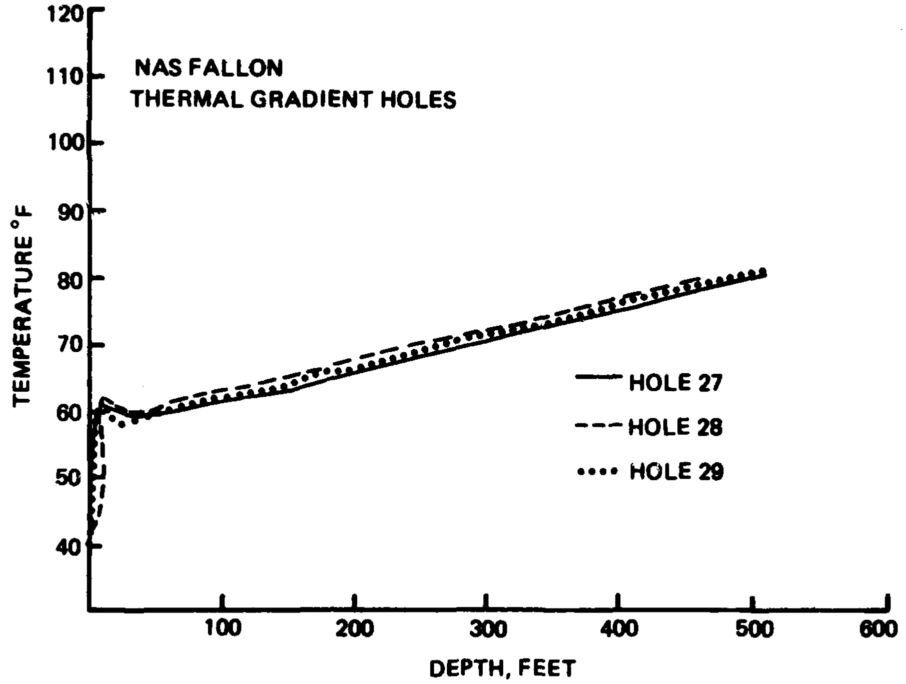
Total depth = 555 feet (169.16 m)
Bottom temperature = 74°F (23.33°C)
Mean air temperature = 53°F
Geothermal gradient = 3.78°F/100 feet
(6.89°C/100 m)

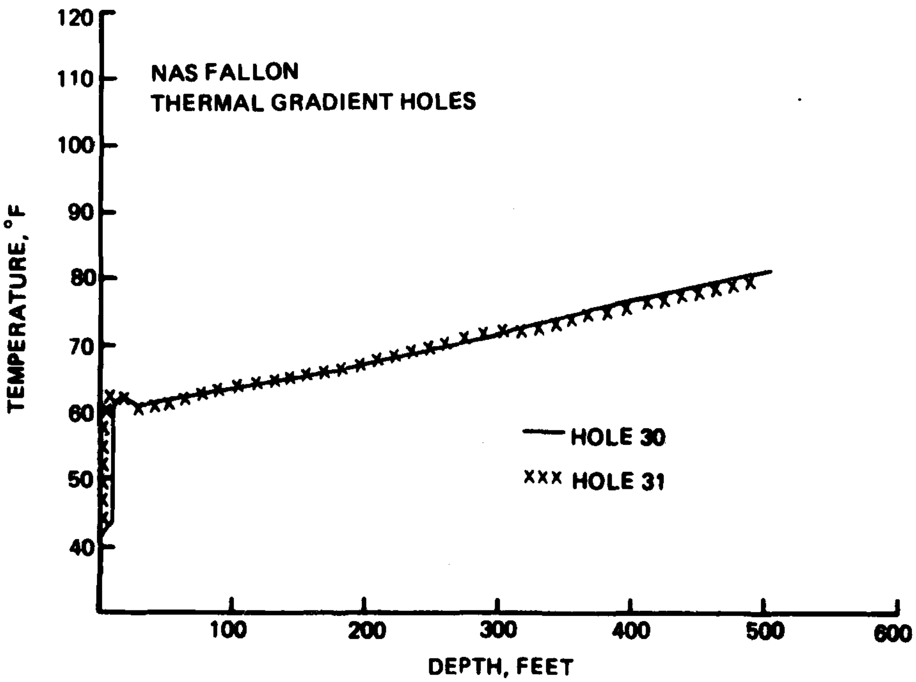

2000 FEET OBSERVATION WELL
NAS FALLON, NV.
LOGGED 11-4-81
TEMPERATURE, °F
220
200
180
160
140
120
100
80
200
400
600
800
1000
1200
1400
1600
1800
2000
DEPTH, FEET

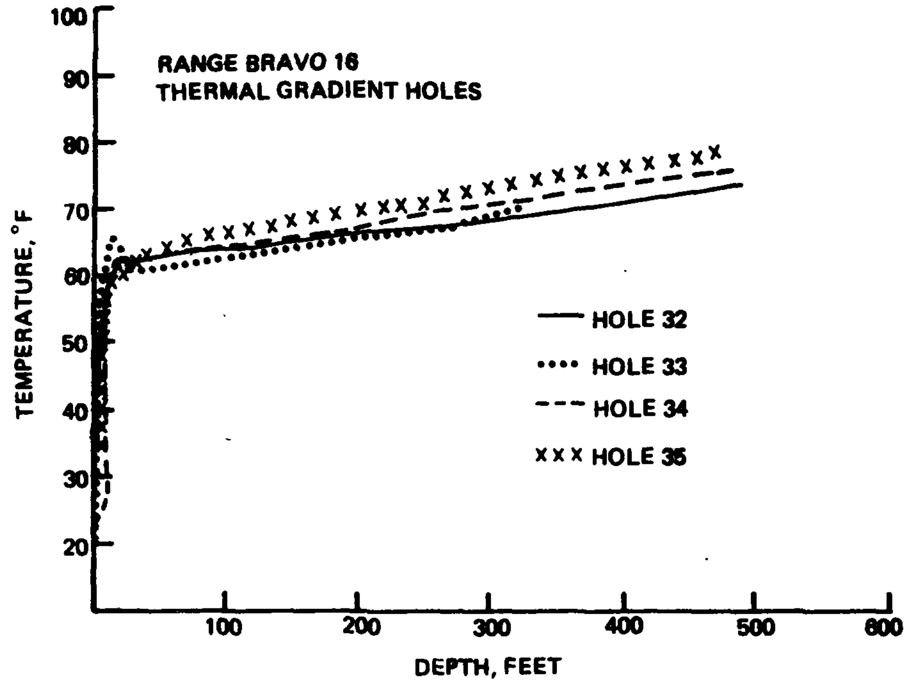

WELL 0
NAS FALLON
1-16-82
TEMPERATURE, °F
140
130
120
110
100
90
80
70
200
400
600
800
1000
1200
1400
1600
1800
DEPTH, FEET

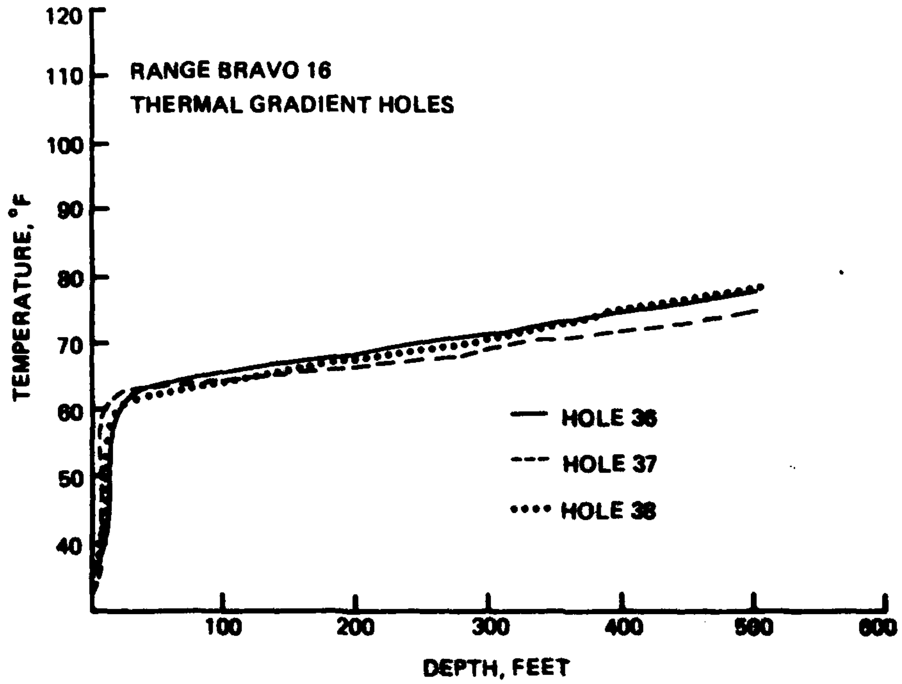

RANGE BRAVO 19
THERMAL GRADIENT HOLES
TEMPERATURE, °F
120
110
100
90
80
70
60
50
40
100
200
300
400
500
600
DEPTH, FEET
HOLE 20
HOLE 21
HOLE 22

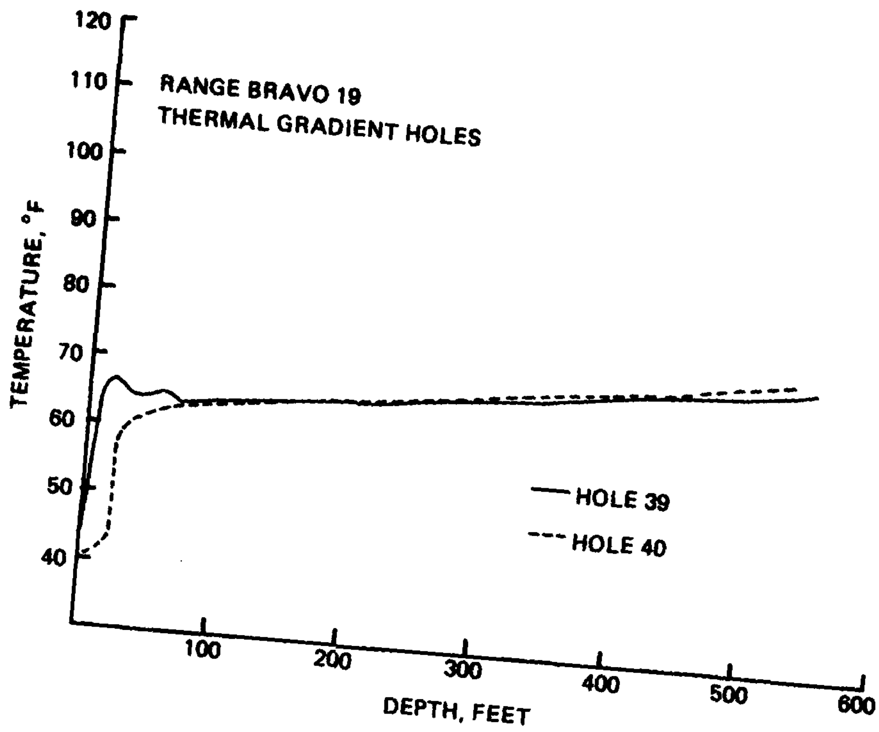

NAS FALLON
THERMAL GRADIENT HOLES
TEMPERATURE, °F
120
110
100
90
80
70
60
50
40
100
200
300
400
500
600
DEPTH, FEET
HOLE 23
HOLE 24
HOLE 25
HOLE 26


NAS FALLON
THERMAL GRADIENT HOLES
TEMPERATURE °F
DEPTH, FEET
HOLE 27
HOLE 28
HOLE 29
120
110
100
90
80
70
60
50
40
100
200
300
400
500
600


NAS FALLON
THERMAL GRADIENT HOLES
TEMPERATURE, °F
DEPTH, FEET
HOLE 30
XXX HOLE 31
120
110
100
90
80
70
60
50
40
100
200
300
400
500
600


RANGE BRAVO 16
THERMAL GRADIENT HOLES
TEMPERATURE, °F
DEPTH, FEET
HOLE 32
HOLE 33
HOLE 34
HOLE 35
100
90
80
70
60
50
40
30
20
100
200
300
400
500
600


RANGE BRAVO 16
THERMAL GRADIENT HOLES
TEMPERATURE, °F
DEPTH, FEET
HOLE 36
HOLE 37
HOLE 38
120
110
100
90
80
70
60
50
40
100
200
300
400
500
600


RANGE BRAVO 19
THERMAL GRADIENT HOLES
TEMPERATURE, °F
120
110
100
90
80
70
60
50
40
HOLE 39
HOLE 40
100
200
300
400
500
600
DEPTH, FEET

Appendix E

CHEMICAL GEOTHERMOMETRY, NAS FALLON, RANGE BRAVO 16 AND RANGE BRAVO 19

NAS FALLON WATER GEOCHEMISTRY

Although water samples were collected from several holes during gradient hole drilling, the results appeared erratic and nonreproducible. Rather than let possible poor data get into the literature, these data are not being published. Well 0, the 1,800-foot (549-m) well with a bottom hole temperature of 130°F (54.4°C) was resampled by NWC personnel on 17 December 1980 and a careful analysis performed. The results are given in Table 1. Experience during drilling indicates that the hydrologic regime at NAS Fallon is complex. More reliable data are necessary before modeling or sophisticated interpretations can be made. Results of chemical geothermometry calculations are given in Table 2.

RANGE BRAVO 16 WATER GEOCHEMISTRY

Only one source of ground water was available for sampling pertinent to Bravo 16; a well located just west of the range near its north end. Results of analyses of two samples, one collected by the Nevada Division of Health 20 December 1976 and the other collected by NWC personnel on 8 February 1979, are in good agreement. Analyses are given in Table 1. Results of chemical geothermometer calculations are given in Table 2. Since the hydrology of the area is not known, no interpretation was attempted.

RANGE BRAVO 19 WATER GEOCHEMISTRY

Four water samples were collected on or in the vicinity of Range Bravo 19: Allen Springs, Lee Hot Springs, Stinking Springs, and Coyote Springs (Table 1).

Allen Spring is a cold (78.8°F or 26°C) spring located just north of Lee Hot Springs, which in turn is just north of the northwest corner of Range Bravo 19. The analyses of Allen and Lee Hot Springs are almost identical, indicating that Allen, a seep, represents leakage from Lee Hot Springs.

Stinking Springs are a group of rather saline springs in the northwest corner of Range Bravo 19. It is probably a water which contains dissolved playa salts.

Coyote Spring is a tiny, very saline seep. It has a very high silica content. It could represent a geothermal fluid leakage possibly mixed with Stinking Spring water. In either case, there has been possible concentration by solar evaporation at the seep.

TABLE 1. Water Analyses at NAS Fallon, Bravo 16, and Bravo 19.[a]

Constituents, ppm	Well 0 NAS Fallon	Well Bravo 16	Allen Springs	Lee Hot Springs	Stinking Springs	Coyote Springs
Calcium	7.5	79.0	38.5	42.0	5.7	17.0
Magnesium	10.5	29.0	0.73	0.40	6.2	1.9
Sodium	2500.0	750.0	445.0	460.0	4400.0	48,000.0
Potassium	30.0	30.0	32.0	30.0	87.0	2100.0
Hydroxide	0.0	0.0	0.0	0.0	0.0	0.0
Carbonate	150.0	0.0	15.3	19.6	255.6	1371.7
Bicarbonate	1105.3	121.3	117.8	103.1	575.2	8939.2
Chloride	3164.8	881.5	380.6	405.7	4842.7	48,286.0
Sulfate	6.0	600.0	410.0	430.0	1700.0	26,500.0
Nitrate	2.7	4.4	<0.5	<0.5	<0.5	16.0
Fluoride	2.80	1.7	8.0	8.7	7.8	165.0
Iron	0.08	4.7	0.20	0.17	0.25	1.3
Manganese	0.07	0.10	0.15	0.05	<0.01	<0.01
Arsenic	0.20	0.20	<0.01	0.03	1.20	1.60
Copper	0.02	0.32	<0.01	<0.01	0.03	0.12
Zinc	0.27	0.70	0.03	0.02	0.02	0.16
Total dissolved solids	7013.0	2518.0	1560.0	1622.0	11,919.0	135,639.0
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.0004
Lithium	0.16	1.6	0.63	0.68	0.3	1.2
Silica	39.0	61.0	110.0	120.0	24.0	170.0
Aluminum	0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Boron	24.0	4.0	1.3	1.3	4.8	63.0
Phosphate	1.4	<0.1	<0.1	<0.1	0.4	5.0
Bromide	5.3	1.6	0.5	1.1	6.0	80.0
Ammonium	4.1	0.1	0.10	0.06	0.08	11.0
Electrical conductivity, microhms	11,000.0	4080.0	2500.0	2500.0	18,000.0	228,440.0
pH	8.8	7.7	8.2	8.2	9.7	9.3
Date sampled	12-17-80	2-8-79	7-21-80	7-21-80	7-21-80	7-21-80

[a]Analyses by B. C. Laboratories, Bakersfield, Calif.

TABLE 2. Reservoir Temperatures as Calculated from Water Analyses.

Geothermometer	Well O NAS Fallon	Well W. of Bravo 16		Allen Springs	Lee Hot Springs	Stinking Springs	Coyote Springs
		1976	1979				
Quartz, conductive cooling[a]	T°C 101		123	156	162	80	186
Chalcedony, conductive cooling[a]	T°C 60		82	117	122	39	146
Quartz, steam flashing[a]	T°C 93		110	137	142	75	159
Na-Li[b]	26		122	96	99	25	155
Na-K (modified)[c]	84	156	149	190	183	109	
Na-K-Ca (B=4/3)[a]	243	135	134	151	145	368	...
Na-K-Ca (B=1/3)[a]	129	152	148	174	167	163	248
Na-K-Ca-Mg[d]	29	44	45	Does not apply		98	Does not apply
Measured temperature, °C		...	20	26	90	28	32
Field pH	...	...	...	7.3	7.3 (hot) 8.6 (cold)	9.9	9.2

[a] R. O. Fournier. "Chemical Geothermometers and Mixing Models for Geothermal Systems," *Geothermics*, Vol. 5 (1977) pp. 41-50.

[b] C. Fouillac and G. Michard. "Sodium/Lithium Ratio in Water Applied to Geothermometry of Geothermal Reservoirs," *Geothermics*, Vol. 10, No. 1 (1981), pp. 55-70.

[c] R. O. Fournier. "A Revised Equation for the Na/K Geothermometer," *Geothermal Resources Council Transactions*, Vol. 3 (September 1979), pp. 221-224.

[d] R. O. Fournier and R. W. Potter. "Magnesium Correction to the Na-K-Ca Chemical Geothermometer," *Geochemica et Cosmochimica Acta*, Vol. 43 (1979) pp. 1543-1550.

INITIAL DISTRIBUTION

4 Naval Air Systems Command
   AIR-00D4 (2)
   AIR-01A (1)
   AIR-4106B (1)
2 Chief of Naval Operations
   OP-413F (1)
   OP-45 (1)
2 Chief of Naval Material
   MAT-08E, CDR Clark (1)
   MAT-08L (1)
1 Commander in Chief, U.S. Pacific Fleet (Code 325)
1 Commander, Third Fleet, Pearl Harbor
1 Commander, Seventh Fleet, San Francisco
7 Naval Facilities Engineering Command
   FAC-03 (1)
   FAC-032E (1)
   FAC-04 (1)
   FAC-08T (1)
   FAC-09B (1)
   FAC-111 (1)
   FAC-1113 (1)
1 Naval Facilities Engineering Command, Atlantic Division (Utilities Division)
1 Naval Facilities Engineering Command, Chesapeake Division (Maintenance and Utilities Division)
1 Naval Facilities Engineering Command, Northern Division (Utilities Division)
1 Naval Facilities Engineering Command, Pacific Division (Utilities Division)
1 Naval Facilities Engineering Command, Southern Division (Utilities Division)
5 Naval Facilities Engineering Command, Western Division
   Code 09B (1)
   Code 09C3 (1)
   Code 11 (1)
   Code 112 (1)
   Code 24 (1)
4 Naval Sea Systems Command
   SEA-05R13 (1)
   SEA-04H3 (1)
   SEA-99612 (2)
1 Commandant of the Marine Corps
1 Naval Academy, Annapolis (Library)
3 Naval Civil Engineering Laboratory, Port Hueneme
   Commanding Officer (1)
   LO3AE, Dave Holmes (1)
   Technical Library (1)
2 Naval Energy & Environmental Support Activity, Port Hueneme
   Code 11011 (1)
   Code 111A (1)

1 Naval Postgraduate School, Monterey (Library)
3 Naval Ship Weapon Systems Engineering Station, Port Hueneme
  Code 5711, Repository (2)
  Code 5712 (1)
1 Naval War College, Newport
1 Headquarters, U.S. Army (DALO-TSE)
1 Chief of Engineers (DAEN-MPZ-E)
1 Construction Engineering Research Laboratory, Champaign (CERL-ES)
1 Facilities Engineer Support Agency, Ft. Belvoir (FESA-TE)
1 Headquarters, U.S. Air Force (AF/LEY)
1 Air Force Systems Command, Andrews Air Force Base (AFSC/DEE)
2 Air Force Academy
  Code LGSF (1)
  Library (1)
1 Air Force Wright Aeronautical Laboratories, Wright-Patterson Air Force Base (AFWAL/POOC)
1 Civil Engineering Center, Tyndall Air Force Base (DEB)
1 McClellan Air Force Base (SMAL/XRE)
1 Department of Energy, Division of Geothermal Energy, Nevada Operations, Las Vegas, NV
1 Department of Energy, San Francisco Operations, Oakland, CA (J. Crawford)
12 Defense Technical Information Center
1 Bureau of Mines, Reno
1 General Services Administration, Public Buildings Service (Energy Conservation Division)
5 United States Geological Survey, Menlo Park, CA
  Dr. Bacon (1)
  Dr. Christianson (1)
  Dr. Duffield (1)
  Reid Stone (1)
  Library (1)
1 California Assembly, Office of Research, Sacramento, CA
1 California Department of Conservation, Sacramento, CA
1 California Department of Water Resources, Sacramento, CA
1 California Division of Mines and Geology, Sacramento, CA
1 California Energy Resources Conservation and Development Commission, Sacramento, CA
1 California State Land Division, Sacramento, CA
1 Associated Universities, Inc., Upton, NY (Brookhaven National Laboratory)
1 Colorado Energy Research Institute, Lakewood, CO
1 EG&G Idaho, Inc., Idaho Falls, ID
1 Geothermal Energy Institute, Natchez, MS
1 Geothermal Resources Council, Davis, CA
1 Johns Hopkins University, Applied Physics Laboratory, Laurel, MD
1 Lawrence Berkeley Laboratory, Berkeley, CA
1 Los Alamos National Laboratory, Los Alamos, NM (Reports Library)
1 Oak Ridge National Laboratory, Oak Ridge, TN (Energy Division)
1 San Diego Gas & Electric Company, San Diego, CA (Otto Hirr)
1 University of Hawaii Institute of Geophysics, Honolulu, HI

FILME

-8